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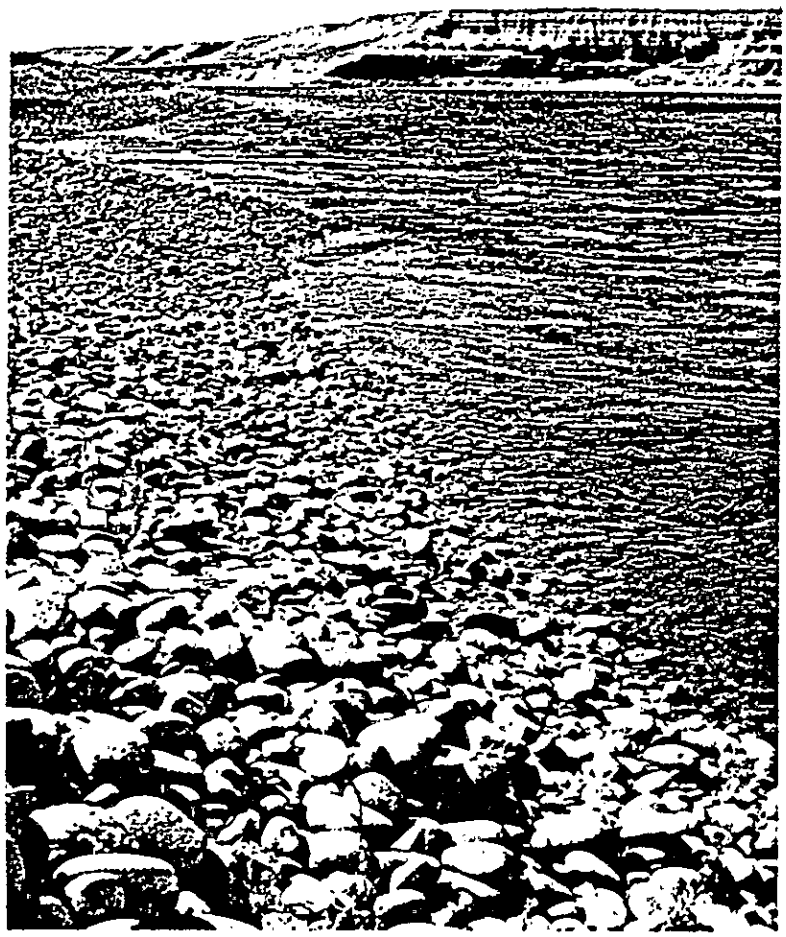
Wildlife Usage, Threatened and Endangered Species and Habitat Studies of the Hanford Reach, Columbia River, Washington



October 1980

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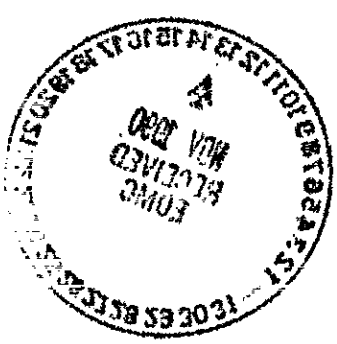

WILDLIFE USAGE, THREATENED AND ENDANGERED SPECIES AND HABITAT STUDIES OF THE HANFORD REACH, COLUMBIA RIVER, WASHINGTON

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ABSTRACT

The Ben Franklin Dam alternative for use of the Hanford Reach, Columbia River, would have a significant deleterious impact on several plant and animal species of special concern and on the threatened bald eagle. The impoundment would potentially cause the extinction of two species (giant Columbia River limpet, great Columbia River spire snail) and the upriver bright race of fall chinook salmon. Nesting sites for many birds would be eliminated including Swainson's hawk, the great blue heron, burrowing owl, and Forster's tern. Habitat and food resources for several other species would be reduced, including roosting sites and the major food source (salmon) of the bald eagle. Two communities of plants dependent on cobble substrate would be eliminated. Newly created riparian habitat would differ from that present now and would enhance the production of weeds, emergent plants and willows, shorebirds, waterbirds, and songbirds as well as their predators.

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EXECUTIVE SUMMARY

This report describes wildlife utilization, threatened and endangered species and other species of concern, and critical habitats within and adjacent to the Hanford Reach of the Columbia River, Washington. Emphasis is on those biotic resources likely to be affected by development of the Ben Franklin Lock, Dam, and Reservoir as an alternative use of the Hanford Reach. Both adverse and beneficial impacts on biotic resources of the dam and resulting impoundment are evaluated and opportunities for enhancement are identified. Measures to mitigate adverse impacts have been discussed wherever they could be identified. These impacts and mitigative actions are summarized in Table S.1.

The bald eagle is the only Federally listed threatened or endangered species that regularly occurs on the Hanford Reach. Impoundment would eliminate salmon spawning and would result in loss of salmon carcasses that are a major food item for overwintering bald eagles. In addition, roosting sites would be inundated by the impoundment.

Peregrine falcons are also federally listed and are potential users of the Hanford Reach, although no nests and few migratory sitings have been recorded within the study area.

Several plant, bird, mammal, reptile, mollusc, and fish species have been identified as species of concern by the State of Washington. Some have also been identified by the U.S. Fish and Wildlife Service as candidates for Federal listing on the Threatened and Endangered Species List. The dam alternative would impact many of them significantly and would affect wildlife use.

Impacts on candidate species for Federal listing include:

- inundation of nearly all existing habitat for Robinson's onion within the study area;
- virtual elimination of the only remaining mainstem spawning area for the upriver bright race of fall chinook salmon, potentially causing extinction of the race;

- additional losses of coho, spring and summer chinook, and sockeye salmon produced upstream from the Hanford Reach;
- loss of steelhead trout spawning habitat and added mortality of steelhead trout produced upstream;
- elimination of the only known habitat suitable for the Columbia River tiger beetle in Washington; and
- elimination of the last known remaining suitable habitat for the giant Columbia River limpet and great Columbia River spire snail, potentially causing their extinction.

Impacts on other species of concern include:

- displacement of three or four nesting pairs of Swainson's hawk;
- reduction in fish food resources used by white pelicans, double-crested cormorants, Forster's tern, Caspian tern, osprey and great blue heron;
- inundation of a major great blue heron rookery;
- elimination of nesting habitat for Forster's tern;
- inundation of eight nest sites for burrowing owls; and
- reduction of habitat for the silver-haired and hoary bats, northern pocket gopher, Ord's kangaroo rat, and short-tailed weasel.

In addition, the dam would cause inundation of 14 islands used by the Great Basin Canada goose for nesting and disruption of nesting on other islands, likely eliminating these geese from nesting on the Hanford Reach. Many other wildlife species including ducks and geese, gulls, quail, pheasant, curlew, shorebirds, owls, hawks, deer, and small mammals are dependent on the riparian zone of the Hanford Reach and would experience displacement or reduction in habitat due to the impoundment.

Two unique communities are dependent on the cobble substrates of the Hanford Reach shoreline and islands. While the individual species present are not in danger of extinction due to the impoundment, they are apparently not found growing together anywhere else and impoundment would eliminate these community types.

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Many long-running ecological field studies would be adversely impacted by the Ben Franklin Dam alternative. For 37 years, aquatic and terrestrial research on the U.S. Department of Energy Hanford Site has contributed to understanding arid land and large river ecosystems.

Mitigative measures such as providing artificial nesting and roosting places, supplemental feeding, or artificial propagation of fish species could be applied to reduce some of the adverse impacts. Such measures have generally not been successful in the past and fail to provide similar aesthetic values to those lost. In some cases no feasible mitigative measures could be identified.

Some enhancement opportunities were noted due to the anticipated increase in backwater areas, muddy shorelines, and emergent weedy vegetation should the Ben Franklin Dam alternative be implemented. These include a potential increase in numbers of shorebirds, waterbirds, songbirds and their predators such as the peregrine falcon. This increase would likely follow an initial adverse impact due to displacement by the impoundment.

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TABLE S.I.
Summary of Effects of the Ben Franklin Dam Alternative on Wildlife, Plants, and Unique Communities (See Figure 1.2 for island locations.)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Wildlife					
Threatened and Endangered Species:[1]					
Bald Eagle *Haliaeetus leucocephalus alascanus*	Riparian areas; roosts in old trees.	Overwinter; feed on salmon carcasses and mallard ducks	25 eagles counted 1979-80; numbers increasing. Present mid-November to early February.	Eliminate major food source and inundate roosts	Supplemental feeding, artificial perches
Peregrine Falcon *Falco peregrinus*	Cliffs and foraging habitats	No nesting observed, potential migration and feeding.	Minimal	Possible increase in prey resources (shorebirds, waterfowl, songbirds).	None needed
Species of Concern:[2]					
Swainson's Hawk *Buteo swainsoni*	Trees and shrub-steppe	Nesting	Abundant, 20 pairs on Hanford Site 4; below 400 ft contour	Displace 3 or 4 nesting pairs	Create additional nest sites at adjacent areas.
Ferruginous Hawk *Buteo regalis*	Rocky outcroppings	Nesting	Uncommon; 1 nest above 2,000 ft contour; siting near sand dunes	None	None needed
Golden Eagle *Aquila chrysaetos*	Shrub-steppe	Overwinters; feeds in riparian zone	Common (8-10 birds per year) ALE Reserve and area from Hanford Townsite to 300A	Eliminate some hunting areas	Provide alternative areas
Sandhill Crane *Grus canadensis*	—	Migration route	Observed frequently overhead in spring and fall; uncommon on ground	None	None needed
Sage Thrasher *Oreoscoptes montanus*	—	Migration route	Uncommon	None	None needed
Pygmy Rabbit *Sylvilagus idahoensis*	Pristine shrub-steppe	Entire life cycle	Small colony on Rattlesnake Mountain above 1,200 ft.	None	None needed

[1]50 CFR Part 17, as published in the Federal Register, 20 May 1980.
[2]Indentified by the U.S. Fish and Wildlife Service as candidates for Federal listing as Threatened or Endangered or by the State of Washington (see text section 3).

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Columbia River Tiger Beetle *Cicindela columbica*	Open sand dunes and bars immediately adjacent to river	Entire life cycle	Not collected in Hanford Reach, but potentially present	Eliminate habitat	None Identified
Oregon Swallowtail *Papilio oregonius*	Tarragon plants (*Artemisia dracunculus*)	Entire life cycle	Uncommon; but host plant is common both above and below 400 ft contour	Eliminate some habitat	Protect Host Plant
Woodhouse's Toad *Bufo woodhousei*	Shorelines	Entire life cycle	Common-White Bluffs Slough and shorelines from 1000 to Hanford Townsite; Island 6	May benefit from increased wetland habitat	None needed
Desert Horned Lizard *Phrynosoma platyrhinos*	Antelope bitterbrush/ big sagebrush	Entire life cycle	Uncommon; no records below 400 ft elevation	None	None needed
Striped Whipsnake *Masticophis taeniatus*	Antelope bitterbrush/ big sagebrush	Entire life cycle	Common; no records below 400 ft elevation	None	None needed
Pacific Gopher Snake *Pituophis melanoleucus catenifer*	Dry area; variety of habitats	Entire life cycle	Common	Eliminate some habitat	Provide alternative areas
Desert Night Snake *Hypsiglena torquata*	Basalt outcroppings	Entire life cycle	Gable Mountain and Gable Butte; not found below 400 ft elevation	None	None needed
White Pelican *Pelecanus erythrorhynchos*	Riparian zone	Overwinter; feeding on fish	8-10 per year from Island 1 to Hanford power line	Reduce or eliminate food resources	Establish a new food resource (fishery)
Double Crested Cormorant *Phalarocorax auritus*	Riparian zone	Infrequent visitor	Colony nested on Locke Island (6) in 1950's but no recent records	Reduce or eliminate food resource	Establish a new food resource (fishery)
Great Blue Heron *Ardea herodias*	Old trees; shallow shorelines	Rookery and feeding	80 nesting pairs near White Bluffs; congregate in open water in winter	Destroy rookery and reduce or eliminate food resource	Establish a new food resource and create a new rookery.
Black-Crowned Night Heron *Nycticorax nycticorax*	Riparian areas	Infrequent visitors in spring and fall	Formerly (1950's) nested on Locke Island. No recent nesting	None	None needed

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Whistling Swan *Olor columbianus*	Riparian areas	Migration route	Flocks of over 50; above Hanford Townsite	None	None needed
Goshawk *Accipiter gentilis*	Wooded riparian zones	Overwinters	Not observed in study area; possibly present	None	None needed
Merlin (Pigeon Hawk) *Falco columbarius*	Sagebrush near riparian areas	Winter	Over 8km from river	None	None needed
Gyrfalcon *Falco rusticolus*	—	—	None observed on Hanford Site; 1 reported nearby	None	None needed
Prairie Falcon *Falco mexicanus*	Cliffs and shrub-steppe	Nesting	1 pair on White Bluffs	None	None needed
Sage Grouse *Centrocercus urophasianus*	Shrub-steppe	—	Frequent along river prior to 1970; only seen on ALE Reserve recently	None	None needed
Forster's Tern *Sterna forsteri*	Cobblestone beaches near water line	Nesting; sensitive to disturbance and water level fluctuations	Common islands 18, 19 and 20; about 400 pairs in Hanford Reach	Reduce or destroy food resource, eliminate nesting	None identified
Arctic Tern *Sterna paradisaea*	Riparian zone	Migration route and feeding	Rarely seen	None	None needed
Caspian Tern *Sterna caspia*	Riparian zone	Feeding	Abundant, especially July-September	Reduce or destroy food resource	None identified
Burrowing Owl *Athene cunicularia*	Shrub-steppe	Nesting	20 to 26 pairs in study area; 8 pair below 400 ft contour	Innundate 8 nest sites	Create artifical nest sites in other areas.
Western Bluebird *Sialia mexicana*	Wooded riparian zones	Spring migrant	Rarely seen	None	None needed
Sage Sparrow *Amphispiza belli*	Sagebrush/bitterbrush and sand dunes; requires shrub overstory	Nesting	Abundant below 400 ft contour from Hanford Townsite to Richland	Reduce Habitat	Provide alternative areas
Merriam's Shrew *Sorex merriami*	Pristine shrub-steppe habitat Rattlesnake Mountain	Entire life cycle	Chiefly above 1,000 ft elevation	None	None needed
Silver-Haired Bat *Lasionycteris noctivagans*	Trees near river and riparian zone	Migration	Common in fall	Reduce wooded habitat	Provide alternative area

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Hoary Bat *Lasiurus borealis*	Trees near river and riparian zone	Migration	Uncommon	Reduce wooded habitat	Provide alternative areas
Pallid Bat *Antrozous pallidus*	Old buidlings	Nesting	Colony of over 100 females near 100F. Probably present in other areas	Reduce habitat	Provide alternative areas
White-Tailed Jackrabbit *Lepus townsendii*	Shrub-steppe	Entire life cycle	Common but none reported east of Highway 240	None	None needed
Northern Pocket Gopher *Thomomys talpoides limosus*	Shrub-steppe	Entire life cycle	Probably limited to east side of Columbia River	Reduce habitat	None identified
Ord's Kangaroo Rat *Dipodomys ordii*	Shrub-steppe	Entire life cycle	East bank and Islands 19 and 20. Probably also Islands 3 and 6.	Reduce habitat	None identified
Northern Grasshopper Mouse *Onychomys leucogaster*	Sand dunes	Entire life cycle	Uncommon but widespread; found below 400 ft contour	Reduce habitat	None identified
Sagebrush Vole *Lagurus curtatus*	Pristine shrub-steppe	Entire life cycle	Principally above 1,000 ft; no records near river	None	None needed
Short-Tailed Weasel *Mustela erminea*	Riparian zones	Entire life cycle	Few records but probably present below 400 ft elevation near river	Reduce habitat	None identified
Osprey *Pandion haliaetus*	Riparian areas, pools and riffles	Feeding on fish	Common visitor, July-December	Reduce or eliminate food resource	Establish a new food resource
Other Wildlife Species in the Hanford Reach:					
Waterfowl					
Great Basin Canada Goose *Branta canadensis moffitti*	Islands and riparian areas	Nesting	Nearly all islands are used for nesting. 156 nests counted in 1980. Hanford Reach supports largest Columbia River goose population	Inundation of islands used by 80% of Hanford Reach goose population for nesting. Loss of nearly one entire age cohort	Irrigated pastures for brood rearing. Artificial nest platforms of questionable value.
Snow Goose *Chen hyperborea*	Islands and open river	Resting stop during migration	—	Loss of habitat	Create stable artificial islands

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Mallard Duck *Anas platyrhynchos*	Islands and open river; nest in dense vegetation near river	Overwintering, nesting, and rearing	Very abundant (60,000 to 120,000) from Island 18 to Yakima River and 100F to Hanford Townsite	Loss of Habitat	Create stable artificial islands
Ring-Billed Gull *Larus delawarensis*	Islands	Nesting	About 5,000 pairs on Islands 18 and 19	Reduction of food resources; possible intermittant flooding of nesting habitat	Control water releases from dam to prevent nest flooding during nesting season
California Gull *Larus californicus*	Islands	Nesting	About 5,000 pairs on Islands 18 and 19	Reduction of food resources, possible intermittant flooding of nesting habitat	Control water releases from dam to prevent nest flooding during nesting season
Upland Game Birds:					
California Quail *Lophortyx californicus*	Abandoned fields and orchards	Entire life cycle	Common	Loss of habitat	None identified
Ring-necked Pheasant *Phasianus colchicus*	Abandoned fields and orchards	Entire life cycle	Common	Loss of habitat	None identified
Mourning Dove *Zenaida macroura*	Trees in dry lands; island cobblestone communities	Nesting	Common on Islands 13, 14, 17, 18, and 19	Loss of some habitat	None identified
Shorebirds and Passerine Birds:					
Long-Billed Curlew *Numenius americanus*	Dry sagebrush/grass; Islands	Nesting and rearing	Common near 100F Slough	Inundation of Island staging areas	Create stable artificial islands, prevent human disturbance of nesting areas
Northern Killdeer Plover *Charadrius vociferus*	Islands and shorelines	Entire life cycle	Common	Inundation of nesting sites on Islands	Create stable artificial islands
Spotted Sandpiper *Actitis macularia*	Islands and shorelines	Entire life cycle	Common	Potential intermittant flooding of islands used for nesting	Control water releases from dam to prevent nest flooding during nesting season
Cliff Swallow *Petrochelidon fulva*	White Bluffs	Entire life cycle	Common	Loss of some nesting and feeding habitat	None identified

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Birds of Prey:					
Great-Horned Owl *Bubo virginianus*	Woods and cliffs, abandoned buildings	Entire life cycle	3 nesting pairs	Displace 2 to 3 pairs from nesting sites	Limit human disturbance; Acquire and protect alternative habitat; artificial nesting sites
Long-Eared Owl *Asio otus*	Abandoned orchards, homesteads, and townsites	Entire life cycle	Common	Displace 6 to 8 pairs from nesting sites	Limit human disturbance; Acquire and protect alternative habitat; artificial nesting sites
Short-Eared Owl *Asio flammeus*	Farmlands and marshes	Nesting, winter visitor	Uncommon within study area but abundant nearby.	Displace 2 pairs from nesting sites	Limit human disturbance; Acquire and protect alternative habitat; artificial nesting sites
Barn Owl *Tyto alba*	Cliffs and abandoned buildings	Nesting	2 to 4 pair reside on Hanford Reservation	Displace 2 to 3 pairs from nesting sites	Limit human disturbance; Acquire and protect alternative habitat; artificial nesting sites
Snowy Owl *Nyctea scandiaca*	—	Winter visitor	Infrequent	Minimal	None needed
Screech Owl *Otus asio*	Trees and fields	Spring/Summer Visitor	Infrequent	Minimal	None needed
Saw-Whet Owl *Aegolius acadicus*	Forest	Spring/Summer Visitor	Infrequent	Minimal	None needed
Flammulated Owl *Otus flammeolus*	—	Spring/Summer Visitor	Infrequent	Minimal	None needed
Marsh Hawk *Circus cyaneus*	Marshlands, tall grassy fields	Nesting	Common on islands and Cold Creek Valley	Displace 6 to 8 pairs from nesting sites	Limit human disturbance; acquire and protect alternative habitat; artificial nesting sites
Red-Tailed Hawk *Buteo jamaicensis*	Poplars and cottonwoods, utility towers, and cliffs over 40 ft high	Nesting	Abundant and present in areas below 400 ft elevation	Displace 2 to 3 pairs from nesting sites	Limit human disturbance; acquire and protect alternative habitat; artificial nesting sites

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
American Kestrel *Falco sparverius*	Old trees, buildings, or cliffs	Nesting	Abundant; nest at White Bluffs and along river	Displace 5 to 6 pairs from nesting sites	Limit human disturbance; acquire and protect alternative habitat; artificial nesting sites
Turkey Vulture *Cathartes aura*	High cliffs	Spring visitor	Rarely seen near Rattlesnake Mountain	None	None needed
Cooper's Hawk *Accipiter cooperii*	Riparian zone	Fall/winter visitor	Common	Reduce habitat	Acquire and protect raptor habitat
Sharp-Shinned Hawk *Accipiter striatus*	Riparian zone and shrub-steppe	Fall/winter visitor	Common	Reduce habitat	Acquire and protect raptor habitat
American Rough-Legged Hawk *Buteo lagopus*	Agricultural fields	Winter visitor	Abundant	Reduce habitat	Acquire and protect raptor habitat
Mammals:					
Mule Deer *Odocoileus hemionus*	Browse and rest under trees; fawning on islands	Entire life cycle	Abundant, mostly confined to west side of river	Inundation of islands used for fawning; loss of wooded habitat	Create artificial islands, manage predators and human disturbance, plant suitable vegetation
White-Tailed Deer *Odocoileus virginianus*	—	—	Occasional	Minimal	Create artificial islands, manage predators and human disturbance, plant suitable vegetation
Coyote *Canis latrans*	—	Entire life cycle	Abundant	Create favorable wetland habitat	None needed
Beaver *Castor canadensis*	Slack water sloughs	Entire life cycle	Unknown	Create favorable wetland habitat	None needed
Muskrat *Ondatra zibethica*	Slack water sloughs	Entire life cycle	Unknown	Create favorable wetland habitat	None needed
Mink *Mustela vison*	Slack water sloughs	Entire life cycle	Unknown	Create favorable wetland habitat	None needed
Racoon *Procyon lotor*	Riparian areas	Entire life cycle	Unknown	Create favorable wetland habitat	None needed
Skunk *Mephitis mephitis*	—	Entire life cycle	Unknown	Create favorable wetland habitat	None needed

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Weasel *Mustela frenata m. erminea*	—	Entire life cycle	Unknown	Create favorable wetland habitat	None needed
Bobcat *Lynx rufus*	—	Entire life cycle	Unknown	Unknown	—
Deer Mouse *Peromyscus maniculatus*	Riparian zone	Entire life cycle	—	Loss of habitat	None identified
House Mouse *Mus musculus*	Riparian zone	Entire life cycle	—	Loss of habitat	None identified
Vagrant Shrew *Sorex vagrans*	Riparian zone	Entire life cycle	—	Loss of habitat	None identified
Montane Meadow Mouse *Microtus montanus*	Riparian zone	Entire life cycle	—	Loss of habitat	None identified
Washington Ground Squirrel *Spermophilus washingtoni*	Riparian zone	Entire life cycle	Limited to east bank of river and islands	Loss of habitat	None identified
Bushytail Woodrat *Neotoma cinerea*	Abandoned buildings and trees	Entire life cycle	Unknown	Loss of Habitat	None identified
Black-Tailed Hare *Lepus californicus*	Sagebrush/grass	Entire life cycle	Unknown	Loss of Habitat	None identified
Cottontail *Sylvilagus nuttallii*	Edge habitats; riparian tree/shrub and sagebrush/grass	Entire life cycle	Unknown	Loss of Habitat	None identified
Plants					
Species of Concern:					
Robinson's Onion *Allium robinsonii*	Silty soil at driftwood line from previous floods	—	Above Vernita, near Coyote Rapids south of 100F Slough, near Hanford Slough, Islands 3, 13, 15, 19 and 20	Inundation of Habitat	None identified
Worm Wood *Artemisia lindleyana*	Sandy and rocky shores	—	Common along shorelines and islands	Displacement from present habitat; readily colonizes new habitats	None needed

TABLE S.I. (Continued)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Columbia River Milk Vetch *Astragalus columbianus*	Open sandy to silty soil	—	Limited; near Priest Rapids Dam above 400 ft contour	None likely unless recreational use of habitat increases	Protect habitat from recreational use
Milk Vetch *Astragalus speirocarpus*	Open sandy to silty soil	—	Sympatric with *Astragalus columbianus*	None likely unless recreational use of habitat increases	Protect habitat from recreational use
Rosy Balsam Root *Balsamorhiza rosea*	Basaltic outcrops on hilltops	—	No suitable habitat within impact zone	None	None needed
Gray Cryptantha *Cryptantha leucophaea*	Stabilized sand dunes	—	Limited to sand dunes; above 400 ft contour	None unless recreational use of sand dunes is permitted	Protect sand dunes from recreational use
Sunflower *Helianthus cusickii*	Dry areas, wide range of soil types	—	Near Ringold; opposite Island 14 above 400 ft contour	None	None needed
Monkey Flower *Mimulus jungermannioides*	Moss mats	—	No known suitable habitat in Hanford Reach	None	None needed
Phacelia *Phacelia lenta*	Bare hills	—	Unknown; possibly sympatric with *Astragalus columbianus*	Unknown	None identified
Cress *Rorippa calycina* var *columbiae*	Moist sand	—	Hanford Slough, 100F Slough	Increased habitat area could extend range and vigor but fluctuating water levels would be detrimental.	Limit extent of water level fluctuations.
Aquatic Organisms Species of Concern:					
Giant Columbia River Limpet *Fisherola nuttalli nuttalli*	Flowing mainstem river; cobble substrate	Entire life cycle	Common	Eliminate suitable habitat	None identified
Great Columbia River Spire Snail *Lithoglyphus columbiana*	Flowing mainstem river; backwater sloughs	Entire life cycle	Uncommon	Eliminate suitable habitat	None identified

TABLE S.I. (Concluded)

Species/Community	Habitat Type	Use	Extent of Use	Effects of Ben Franklin Dam	Mitigative Measures
Upriver Bright Fall Chinook Salmon *Oncorhynchus tshawytscha*	Flowing mainstem river; backwater sloughs	Spawning and nursery	Nearly 3,000 Redds producing 1.4 million smolts per year plus 3 to 4 million hatchery smolts per year	Eliminate suitable habitat; probable loss of this race of salmon. Inundation of artificial rearing facilities result in loss of 4 to 5 million smolts per year	Increased hatchery production
Spring and Summer Chinook Salmon *Oncorhynchus tshawytscha*	Flowing mainstem river	Migration routes	7,000 to 25,000 adults and 2 to 4 million smolts per year	Loss of 492,000 to 726,000 smolts per year due direct and indirect mortalities	Increased hatchery production
Coho Salmon *Oncorhynchus kisutch*	Flowing mainstem river	Migration routes	500 adults and 600,000 smolts per year	Loss of 228,000 smolts per year	Increased hatchery production
Sockeye Salmon *Oncorhyncus nerka*	Flowing mainstem river	Migration routes	45,000 adults and 1.6 million smolts per year	Loss of 240,000 smolts per year	Increased artifical production
Steelhead Trout *Salmo gairdneri*	Flowing mainstem river	Spawning and migration route	Est. 10,000 spawners produce 1.6 million smolts per year plus about 160,000 hatchery smolts	Eliminate suitable habitat and inundate artificial rearing facilities. Loss of 1.8 million smolts per year.	Increased hatchery production
Communities of Concern:[1]					
Cobblestone Beach Community	Cobble shorelines (moist)	Summer-blooming forbs eg., Columbia River Grindelia, Columbia Coreopsis	Throughout Hanford Reach in narrow band along river, extensive gravel bars	Inundation and loss of habitat	None identified
Island Cobble Community	Cobble substrate on islands (semi-arid)	Northern Buckwheat Lupine Absinthium	20 Islands in Hanford Reach	Inundation and loss of habitat in 15 islands (670 ha)	None identified

[1]See text section 4.

CONTENTS

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FIGURES

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TABLES

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1.0 BACKGROUND

1.1 OBJECTIVES

The Seattle District, Corps of Engineers, is conducting a study of the alternative uses of the Hanford Reach of the Columbia River under the authority of a congressional resolution adopted 28 May 1959. One of the alternative uses involves the construction of the Ben Franklin Lock, Dam and Reservoir for hydroelectric power generation and navigation. The Hanford Reach (Figures 1.1 and 1.2) is the only unimpounded portion of the Columbia River above Bonneville Dam in the United States. As a result, its present resources include aquatic and riparian habitats that are unique to the Columbia River Basin. The purpose of this study is to identify and describe present wildlife usage patterns, threatened and endangered species, and critical and unique habitats within the Hanford Reach and to evaluate the impacts of the Ben Franklin Dam alternative on the study elements. Measures to avoid or mitigate adverse impacts and enhancement opportunities are also considered. Several species of concern are identified and discussed. While these are not Federally listed as Threatened or Endangered at present and thus have no protection under the Endangered Species Act, they do have a potential for Federal listing in the future. The general study area consists of the area between Priest Rapids Dam and Richland, Washington from the Columbia River to 1 mile beyond the 400 ft (112 m) contour line. This includes the entire land area that would be affected by the Ben Franklin Dam alternative; however, ranges of some species considered span other habitats at Hanford. Within the general study area, studies of particular elements were further limited to known or likely habitats on the basis of our extensive experience researching wildlife use on the U.S. Department of Energy Hanford Site. Aquatic resources and riparian vegetation were specifically considered in a previous study which describes effects of the Ben Franklin Dam alternative on them (Fickeisen et al. 1980, Warren 1980). Riparian resources of the Hanford Reach were also summarized recently by Rickard et al. (1980).

Assumptions about the configuration of the dam and its operating characteristics were taken from an earlier study (U.S. Army Corps of Engineers 1969). That study indicates that the dam would be located 10 miles (16 km) above Richland at river mile (RM) 348 or river kilometer (Rkm) 560 and would cross

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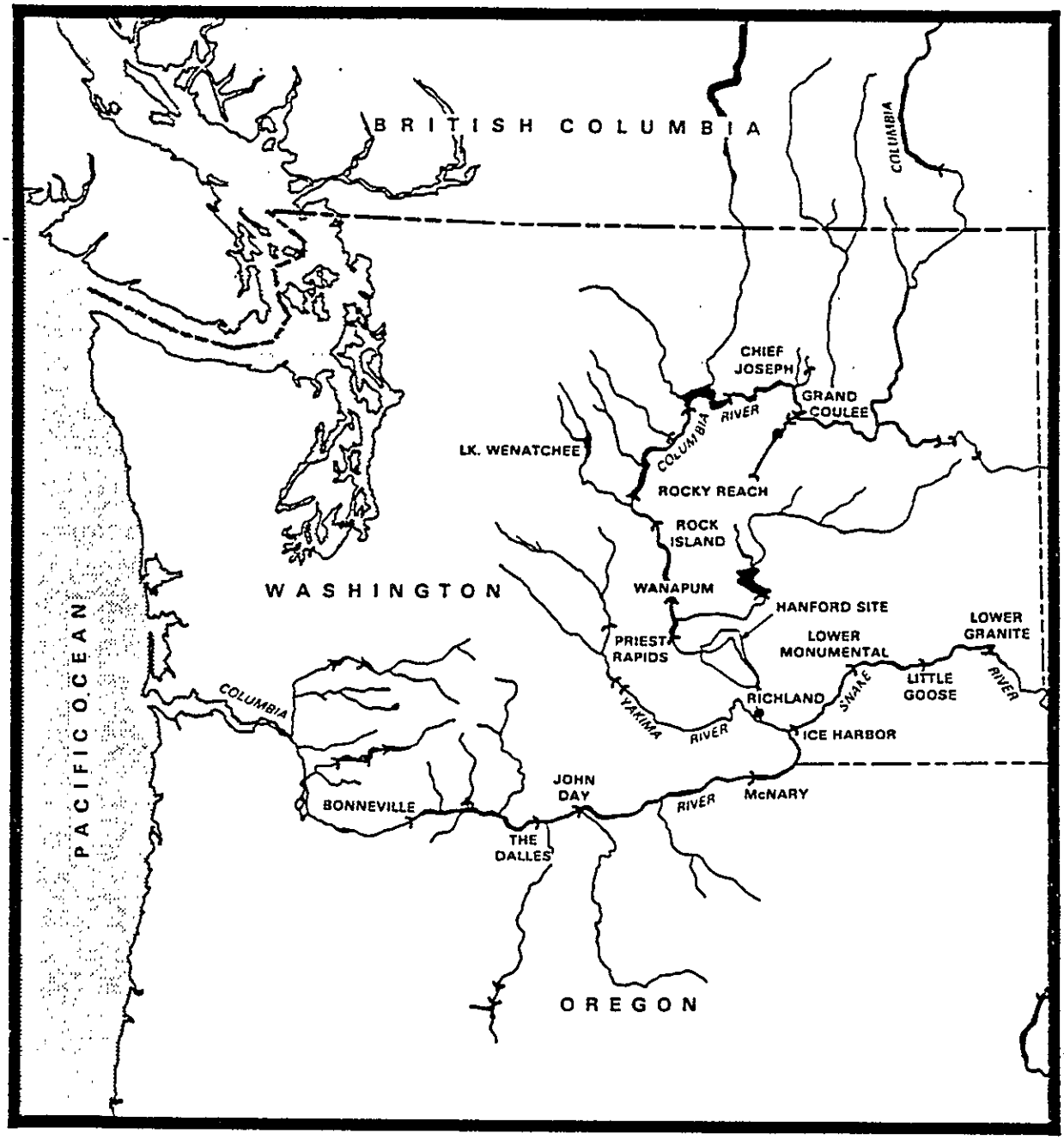

FIGURE 1.1. Columbia River and Environs

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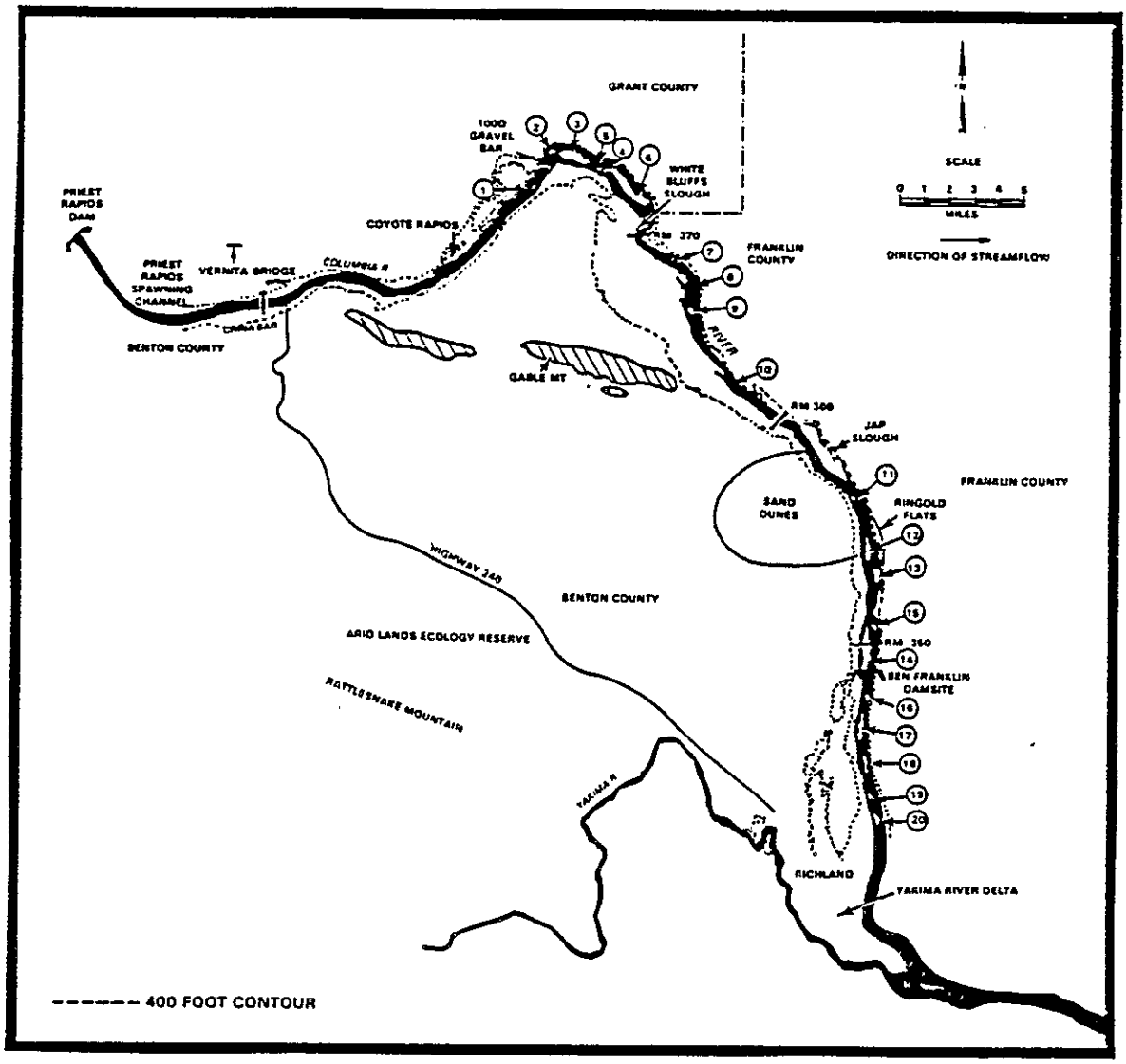

FIGURE 1.2. Hanford Reach of the Columbia River. Circled numbers represent islands.

Wooded Island. The dam would have a normal full pool elevation of 400 feet (122 m) above mean sea level (MSL), impounding the river above the damsite to Priest Rapids Dam (RM 397, Rkm 369). The reach, about 50 miles (80 km) long, would be converted to a run-of-river reservoir with a minimum elevation of 390 feet (119 m). The configuration of the dam and associated locks are described in the materials mentioned above.

Our analysis is based on existing information with field confirmation as required. A major portion of the effort was expended searching likely habitats within the study area for the species of concern. Field studies were hindered by higher-than-expected peak runoff conditions and by deposition of volcanic ash from eruptions of Mt. Saint Helens in southwestern Washington. These factors precluded or made access to some habitats during the optimum search period for spring and early summer blooming plants difficult. The study employed data collected within the study area and reasoned projections of probable effects of hydroelectric development based on anticipated physical changes in habitats and the likely response of biota to those changes. Experience at other hydroelectric installations was considered where applicable.

The information resulting from our field observations has been combined with data from past research efforts. Many of the data presented here have not been previously published and this report represents a new synthesis of these unpublished data, pertinent published information, and results of field studies conducted under this project.

Our conclusions are based on the best available information. In some cases, which we have identified in the text, the available information is incomplete. The analysis is based on reasonable assumptions given the present state of the art. Our discussions are not a prediction of future conditions but are reasonable interpretations of the Hanford Reach ecosystems and projection of likely effects of the major physical changes associated with construction of a dam alternative.

The Hanford Reach of the Columbia River has been the site of ongoing field ecology studies since 1943. The U.S. Department of Energy has established a National Environmental Research Park (NERP) which includes the Arid Lands

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Ecology Reserve on the Hanford Reservation. Nearly 40 years of competent aquatic and terrestrial ecosystem research mark the Hanford Reach as one of the most unique research areas in the world. Data collected on the Hanford Reach have provided mankind with a wealth of information about ecosystem functioning, effects of perturbations on flora and fauna, and habitat requirements of arid region organisms. In addition, the NERP provides a refuge from the effects of industrial, agricultural, and urban development that is important to the continued well-being of many plant and animal communities. The Ben Franklin Dam alternative would change the physical habitat characteristics so severely that many on-going long-term studies would be terminated as a result of loss of the study sites.

Many measures are available that could be implemented to mitigate the adverse environmental impacts of the Ben Franklin Dam alternative. These involve enhancement or modification of habitat or are artificial. Such measures usually are directed away from the stable end point of natural progression and thus require continued management, maintenance, and energy inputs. Past experience suggests that mitigation measures are often ineffective and fail to provide pre-impact production and population levels of the target species. Furthermore, natural systems have many inherant interactions that provide an esthetic value to many people; such losses cannot be compensated for. As our society moves toward increasing manipulation and control of the environment, our values change and our perspective may become increasingly short-sighted.

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1.2 VALUE OF RARE AND ENDANGERED SPECIES

The earth's biosphere is characterized by its great diversity of habitats, plants, and animals. This richness and resulting complex biological relationships contain a vast amount of genetic information that integrates the evolutionary experience of life since its first appearance on earth. The large scale stability of ecosystems, in response to gradual or catastrophic changes in the physical environment, is dependent on the diversity of life strategies present in the constantly changing assemblage of species and their genetic information.

Ecosystem diversity can only be maintained by the careful protection of each of the system components, individual habitats and species around us. By hastening the extinction of a species or by destroying a unique habitat, we force a simplification of the ecoystem at the expense of its interrelated complexity and ability to function as a unit (Milton 1970).

As a result of man's activities, the rate of extinction of species has increased dramatically in recent decades and further increases are predicted in the future (Council of Environmental Quality, 1970). This phenomenon has not been balanced by increased rates of speciation, so the net effect has been and continues to be a reduction in the amount of genetic information contained in the biosphere.

Even when individual species are not driven to extinction, irreversible changes may result from man's activities that cause loss of habitat or communities; the processes by which they were created may never recur. This loss reduces the ability of species that have evolved life strategies matched to that particular niche to continue their survival. A loss of vigor in a population makes it all the more vulnerable to extinction as a result of other human activities or natural catastrophies (Study of Critical Environmental Problems, 1970).

Our knowledge of the ecological relationships around us is far from complete and our limited understanding contains many errors. We have yet much to learn about about the species that co-inhabit the biosphere with us and about their interrelationships. By causing their extinction, we deny ourselves and future genertions the ability to understand potentially important aspects of our natural heritage (Allen 1966). All to often we fail to understand ahead of time the consequences of extinction which may lead to widespread undesirable changes (Study of Critical Environmental Problems 1970).

Mankind reaps many benefits from plant and animal products, some of which are unique to a particular species and for which we have no readily available substitute. Because our knowledge is imperfect, we cannot predict with certainty that a particular species will or will not be found to produce an important material in the future. However, past experience teaches us that the inventory of useful materials has increased with time and will likely continue

to do so. The loss of a species represents the loss of a genetic potential which may have a value in the future, but that cannot now be predicted. Prudence dictates that we maximize our future options by conserving the diversity of genetic material available now.

A full complement of species and habitats provides a sense of identification and a oneness with natural surroundings for many. The esthetic value of the wilderness experience cannot be quantified in standard economic terms for comparison with the benefits and costs of a particular project. Nonetheless, the value is not insignificant. Many feel that their spiritual health is closely related to the quality of their experience with nature.

Religious and spiritual teachings assign to man the responsibility to be "masters of the fish and birds and all the animals" (Genesis 1:28). With this charge is the responsibility to behave as a wise and beneficent master, looking after the protection of species.

Extinction of a species is irreversible: man does not possess the ability to replace a species or its unique genetic complement after it has been extirpated. Nor do we understand the building blocks of life well enough to describe fully a particular species and the information it carries.

Perhaps the case for preservation is best argued simply as did Ehrenfeld (1976): "They should be conserved because they exist and have existed for a long time. Long-standing existence in nature is deemed to carry with it the unimpeachable right to continued existence. Existence is the only criterion of value, and diminution of the numbers of existing things is the best measure of decrease of value."

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2.0 WILDLIFE USE

2.1 INTRODUCTION

The Hanford Reach of the Columbia River is recognized as an important ecosystem where numerous species of animals characteristic of the Columbia Basin find refuge in the midst of urban and agricultural expansion. The Hanford Reach and the entire Hanford Site may soon be an island refuge for native flora and fauna surrounded by cities and agrarian development. Hanson and Eberhardt (1971), Fitzner and Hanson (1979), Rickard et al. (1980), Hedlund (1975) and Fitzner (1980b) have all discussed the uniqueness of the Hanford Site in relation to various wildlife species. This section of the study on the Hanford Reach of the Columbia River for the Seattle District, U.S. Army Corps of Engineers is designed to evaluate the effects of the Ben Franklin Dam alternative on wildlife use. Particular attention is paid to the extent wildlife depends on the Hanford Reach.

The objectives of the wildlife use study were to identify present wildlife usage adjacent to the Hanford Reach, including characterization of habitat use, species abundance and spatial and temporal distribution. This information was gathered from available published reports, personal knowledge of Battelle researchers and field observations made in the spring and summer of 1980.

Precise prediction of impacts on wildlife and assessment of the significance (short- or long-term; local or regional) is not possible at this time because no comprehensive data base exists comparing pre- and post-impoundment wildlife populations. On the basis of professional experience and limited understanding of existing conditions, we have been as precise as practicable in forecasting impacts.

We suggest that field studies be conducted in areas which have been impounded along the Columbia and Snake Rivers relating habitat types to wildlife species distribution and density. These studies should be done in conjunction with similar studies on the unimpounded Hanford stretch. Care should be taken to select areas which once had habitats similar to Hanford (i.e., McNary and Priest Rapids pools). We know the histories of each dam and could

compare known age succession with species density and distribution data. This could provide us with a better understanding of enhancement potential and the significance of impact of the Ben Franklin Dam alternative.

Our data were gathered from field work and combined with data from past research efforts to provide the Army Corps of Engineers with a comprehensive description of wildlife use of the Hanford Reach. Much of the historical data have never been published and are presented here for the first time. One of our ultimate objectives was to discuss the potential effects of the Ben Franklin Dam alternative on wildlife usage, including a discussion of enhancement opportunities, mitigation actions, and needed future studies. Potential impact of the Ben Franklin Dam impoundment, dam construction and operation are addressed here in terms of effects to individuals, populations, and communities.

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The field work began in April with aerial and ground surveys. We examined all cliff line habitats along the Columbia River from the Beverly Gap above Priest Rapids downstream to Richland. Peregrine falcon nests in particular, but also nests of all raptor species were recorded. Field work continued with bird nesting surveys on the Hanford Reach islands (1 to 20). Canadian geese, ducks, shorebirds, upland game birds, gulls and terns were observed. Songbird and upland game bird surveys were also conducted in riparian, island, sand dune, wooded, sagebrush, cheatgrass, and bitterbrush habitats. We also conducted extensive searches of all areas along the Columbia River shoreline to one mile beyond the 400 ft (122 m) contour.

2.2 BIRDS

2.2.1 Geese and Ducks

The resident Great Basin Canada goose (Branta canadensis moffitti) population on the Hanford Reach (Figure 2.1) has been regularly censused since 1950 (Hanson and Browning 1959; Hanson and Eberhardt 1971; Rickard and Sweany 1977). Nesting has been almost entirely confined to 20 islands scattered throughout the Hanford Reach (Figure 1.2), with less than 1 percent of the nests located on the sand and clay cliffs bordering the river on the east (Figure 2.2). The number of goose nests established on these islands has

fluctuated from year to year, but with a general decline in numbers overall (Figure 2.3). As many as 300 goose nests were present in the early 1950's; in 1976, however, only 77 nests were located on these islands. One of the main reasons for the marked decline in goose nests is predation by coyotes. Predation has occurred from time to time on most of the islands, but resident coyotes have totally discouraged goose nesting on Island 6 (Locke Island), which formerly supported 100 nests. Since the mid-1960's Hanford Reach geese are strongly imprinted to natural nesting habitat, and in 3 years only 10 pairs nested in 100 nesting platforms, with lower than expected production.

The goose nesting population along the Hanford Reach is the largest of those along the Columbia River, although nesting populations may be found both upstream and downstream from the Hanford Site. Gibson and Buss (1977) report that the creation of slack water behind a series of dams along the lower Snake River has all but eliminated the nesting population from that section of the Snake River. Nevertheless, a few geese still nest along the river by placing nests on ledges of steep basalt cliffs. Impact assessment of the Ben Franklin Dam alternative on the Hanford Canada goose population was addressed by Hanson and Eberhardt (1971). Little has changed since this study, so their discussion is presented here:

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The Proposed Ben Franklin Dam

"The specificity of geese for certain islands was clearly demonstrated by the behavior of birds driven from Island 6 by coyotes during several years. They refused to utilize adjacent islands or river bluffs which apparently had sufficient nesting territories to accommodate at least a portion of the displaced birds, and there were sufficient numbers involved that their presence on other islands would have been noted. This behavioral phenomenon was also observed in the John Day Dam impoundment, where most birds returning to their inundated nesting area appeared incapable or unwilling to accept their modified environment for some time (E. Bowhay pers. comm. 1970) and tended to nest in unusual densities on a few islands thereafter. Such performances have particular application in assessing the probable effect of the proposed Ben Franklin Dam upon the Hanford goose population.

Inundation of the 14 islands used by 80% of the Hanford geese for nesting would be a major blow to the population by loss of nearly an entire age cohort. New nesting habitat created by the impoundment would subsequently be utilized in unusual ways that could result in considerable intraspecific strife and might attract appreciable predation. The light soils of newly created islands in the impoundment would probably erode under the influence of water and wave action similar to islands of comparable characteristics in the impoundment behind the John Day and McNary Dams; therefore, riprapping or other bulwarks should be added to the new islands to prevent such destruction of habitat. Construction of artificial islands from peninsulas should be guided by characteristics of the most successful islands of the present natural habitat. A substantial nest base is the most essential factor, with visibility from the nest and other accessory requirements having been reported to have definite influences upon production (Williams and Marshall 1937: 83, Williams and Sooter 1940:383, Williams and Nelson 1943:341).

The possibility of offsetting nesting losses by erection of artificial nesting platforms such as those used to varying degrees by other populations (Yocom 1952, 1956; Craighead and Stockstad 1961:363–372; Dimmick 1968:41, Rienecker 1971:121) is questionable. A few artificial platforms were tested at Seney, but were not used by the geese there (Sherwood 1965:91). Such installations are expensive, are alien to current nesting behavior, and probably require a gradual experience of adaptation by the geese rather than the abrupt environmental change that has prevailed in dam impoundments in the past. Placement of a few platforms to accommodate more than 200 territorial pairs in the midst of a traumatic behavioral experience would be tokenism. Sufficient time prior to inundation of the present nesting islands should be allowed for adaptation; the utilization of river bluff nesting sites by 1–3% of Hanford geese may represent a step toward platform nesting or at least an indication it might be encouraged. The specificity of geese for their ancestral islands attests to the complex behavioral response that one must deal with in such a situation and strongly suggests that considerable planning is necessary to successfully resolve the problems.

One of the most important considerations in evaluating nesting habitat loss would be replacement of brood rearing areas, particularly near Islands 6 and 12. Several

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abandoned farms in the White Bluffs and Ringold areas should be irrigated and pasturage provided. Such areas would provide ideal brood rearing and banding sites and should be managed as such, with sharecropping a secondary consideration. Wintering geese would also use the areas extensively and provide conditions for study of goose family behavior during the reassembling of families following the nesting season. At the present time, wintering geese concentrate on the lower 3 islands of the study area, within the sanctuary of the City of Richland, and in the secured region between Island 1 and the west boundary of the Hanford Reservation. Autumn rains and the resultant sprouting of brome grass, *Bromus tectorum*, are prime factors influencing the distribution of the geese, which are subjected to considerable hunting pressure on the lower part of the study area and tend to move into the interior of the Hanford Reservation when sufficient green brome grass is available. During the winter of 1968, 80% of an estimated 50,000 wintering geese moved upriver as the sprouting brome provided food in the Hanford sanctuary. Irrigated pastures could thus be utilized year around and provide means of redistributing goose populations in response to management needs."

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Migrant ducks and geese, including snow geese (Chen hyperborea), have historically used the Hanford Reach as a resting stop in fall and winter. They make foraging flights to surrounding fields and rest on the islands and water at other times. Presently the Hanford Reach serves as a winter refuge for nearly 100,000 ducks, mostly mallards. In the 1960's over 200,000 ducks wintered here. The population maxima for each year since 1961 through 1979 (Figure 2.4) reveal that large fluctuations in numbers of wintering ducks occurred from year to year with a definite drop occurring from the 1960's to the 1970's. This drop is difficult to interpret; however, increased agricultural conversion of lands along the Columbia and Snake River systems have provided more feeding areas for the birds which may be causing ducks to shift wintering areas.

Three major events related to human disturbance of waterfowl have occurred since 1966. In the fall of 1966, Islands 12 through 17 were opened to hunting. These islands had previously served as refuges. In the fall of 1968 the river was opened to hunting from Island 12 to the Hanford powerline (RM 362.3, Rkm 579.7). This meant that only the stretch of river from Vernita Bridge downstream to the Hanford powerline row served as refuge. During the last two weeks of waterfowl hunting season in the winter of 1977-78, the U.S. Coast Guard declared all of the Hanford Reach open to public boating. This caught

land and wildlife management agencies by suprise and regulations governing human recreation use of the Hanford Reach were instigated by the 1978-79 hunting season. These regulations permit boat traffic but no hunting of waterfowl from the Hanford powerline to Vernita. The impact of these three events on waterfowl use of the Hanford Reach is unclear, but Figure 3.4 clearly shows that since the two major human disturbance factors of the 1960's, waterfowl populations have steadily declined along the Hanford Reach. The extent to which other factors have interacted with human disturbance to reduce wintering waterfowl populations is a subject of several present investigations.

The major winter use areas for waterfowl on the Hanford Site today occur from the lower end of Island 18 downriver to the Yakima River Delta and from the Hanford townsite powerline (RM 362.3, Rkm 579.7) upstream to the 100 F Area.

Peak waterfowl use of the Hanford Reach occurs from late December through early January. Data on winter use collected during the 1970's (Figure 2.5) reveal that ducks begin to move on to the Hanford Reach in November and increase in numbers, peaking in December or January. By mid-January, waterfowl populations drop off quickly and only a few birds remain by late February.

Besides serving as a wintering area for mallards, the Hanford Reach is also used for nesting and brood rearing. Data on 30 mallard nests have been collected since the early 1970's. The earliest reported nesting was on April 3 and the latest nesting was observed on May 8. These nests contained 14 and seven eggs respectively and most likely were complete clutches. The May 8 nest contained pipped eggs but the April 3 nest did not. By allowing for one egg lay per day (assuming the April 3 nest to be a complete clutch), March 20 is arrived at as the earliest date for the initiation of egg laying by mallards along the Hanford Reach. An earlier date may be in order depending on the assumed stage of incubation of the April 3 nest.

Of the thirty nests observed, only ten had complete known histories (i.e., laying date, hatching date). Egg laying began during early April (4th through 12th) in eight of these nests and in late April (25th through 27th) for the other two. Incubation began in mid-April for eight nests (14th through 22nd),

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with two beginning in early May (5th through 7th). Young hatched during early May (1st through 8th) for eight nests and during late May and early June for two others. Yocom and Hansen (1960) studied waterfowl nesting in eastern Washington in the late 1940's and early 1950's and indicated that peak hatching time over the years depended on weather and ranged from the third week in May through the third week in June. Hatching dates for all nests however ranged from early April through July.

Mallards were observed nesting (Figure 2.6) mostly on islands in the Columbia River, but a few were observed along the shoreline. Shoreline nesting was no doubt more commonplace than we observed, since islands were searched more intensively than shorelines. The principal requirements for mallard nesting appeared to be a clump of dense vegetation, near water (Figure 2.7). Patches of currant (Ribes cereum), willow (Salix exigua), lupine (Lupinus sp.), absinthe (Artemisia absinthium), horesetail fern (Equisetum sp.), ryegrass (Agropyron dasystachyum) and Russian thistle (Salsola kali) provided for most nesting. Currant and absinthe habitats together provided for 20 percent of all nesting. Islands 11, 12, 13, 14, 15, 17, 19 and 20 were used for nesting. Island 19 accounted for over 50 percent of all observed nestings.

The mean clutch size for eleven nests with known complete clutches was 9.7 ± S.E. 0.70, which is within the range for clutch sizes reported by Kortright (1967).

Members of the Lower Columbia Basin Audubon Society regularly census wintering populations of waterfowl along the Columbia River near Richland during the annual Christmas bird counts (American Birds 1978).

The Ben Franklin Lock, Dam, and Reservoir alternative would inundate 14 islands used by waterfowl (ducks, geese, swans and coots) as wintering habitat and would also eliminate waterfowl nesting. Besides elimation of islands for loafing areas and nesting habitat, the Ben Franklin Dam alternative would cause a deterioration in habitat quality of the wetlands throughout the Hanford Reach. Control of daily water level fluctuations through impoundment would eliminate plant communities (shoreline sedges and grasses and wild onion beds) which presently provide food for waterfowl. The creation of impoundments along

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the lower Snake River has all but eliminated bushy shorelines, bottomlands and island habitats used by wildlife; riprapping of embankments has precluded the establishment of vegetation (Armacost 1979). The creation of the Ben Franklin impoundment can be expected to have similar consequences, at least in the short run. Over the years, environmental changes caused by impoundment may also result in the redistribution of waterfowl populations throughout the affected area (Johnsgard 1956).

2.2.2 Fish-Eating Birds

In the 1950's and 1960's ring-billed (Larus delawarensis) and California (L. californicus) gulls nested on Island 1 near Coyote Rapids and on Island 12 near Ringold Springs (Hanson 1963). However, in the early 1970's gulls abandoned these islands and colonies are now present on Islands 18 and 20 (Figure 2.8) near the City of Richland (Figure 1.2). Surveys in 1977 revealed that 4755 pairs of California gull and 4601 pairs or ring-billed gulls nested on the two islands (Conover et al. 1979). Recent nesting population surveys show that approximately 5250 California gull pairs and 5100 ring-billed gull pairs (Figure 2.9) nest on the two islands. About 8450 young gulls were banded with Fish and Wildlife Service metal leg bands during the years 1956 through 1970. Preliminary analyses of band returns indicate that Hanford gulls move westward to the Pacific coast and northward into British Columbia during their first migration flights. Subsequent band recoveries have mostly been reported from the coastal areas of California and Mexico, with scattered reports from inland areas of the western U.S. (W. C. Hanson, Battelle unpublished). Forster's terns (Sterna forsteri) (Figure 2.10), also nest on Islands 18, 19 and 20 on bare cobblestone substrate close to the water line. Fluctuations in water level caused by upstream dams sometimes innundate nests. It is estimated that about 400 pairs of these small terns nest along the Hanford Reach.

A colony of double-crested cormorants (Phalacrocorax auritus albaciliatus), estimated at 55 to 65 birds, nested on Locke Island during the mid-1950's (Hanson 1968). This colony was abandoned in 1957 because of the intense competition with great blue herons for nesting sites in a few low-statured mulberry trees. Occasionally a few birds have been seen on the Columbia River between Richland and Ringold Springs in the winter. From 1950 through 1967,

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15 to 20 white pelicans (Pelicanus erythororhynchos) regularly used the Hanford Reach as a foraging stop in migration. In 1979, the number had dwindled to less than 10. A few American mergansers (Mergus mergenser) also nest and raise their young along the Columbia River. Great blue herons (Ardea herodias, Figure 2.11) and black-crowned night herons (Nycticorax nycticorax) have nested along the Columbia River for many years. Hanson (1968) noted a small colony on Locke Island that contained 10 to 16 nests of each species during the 1950's. The number of great blue herons using the Columbia River has increased in recent years. At the present time about 80 pairs nest in a grove of trees near the White Bluffs Ferry Landing (Figure 2.12). Nesting colonies are widely scattered in interior Washington probably because of the scarcity of suitable trees. A large mixed colony of about 1000 great blue and black-crowned night herons has recently become established in peach-leaf willow trees on the northern extremity of the Potholes Reservoir in Grant Co. (Fitzner et al. 1978). Another colony of great blue herons is located on the Umatilla Wildlife Refuge along the Columbia River near Umatilla, Oregon.

The Ben Franklin Lock, Dam, and Reservoir alternative would impact gulls and terns initially by reducing food supplies. Prediction of long term effects would require additional study of gull and tern life histories. Small fish reared in the fast moving waters of the Hanford Reach serve as food, particularly for the terns. Since the gull and tern colonies are downstream from the proposed dam, no permanent flooding of this island nesting habitats would result. Water fluctuations after the proposed dam construction would, however, be expected to inundate islands on a daily basis, depending on water outflow related to power demands. The heron colony at White Bluffs would disappear as a result of the inundation of the nesting trees. Cormorants, white pelicans, mergansers, and other fish-eating birds which visit the Hanford Site would disappear from the area initially. If conditions after impoundment favor fish production in the reservoir, then some fish-eating birds would probably benefit ultimately.

Mitigation effects of the proposed Ben Franklin Dam alternative on fish-eating birds, should include a creation of heron nesting habitat by planting trees. Man-made islands could also be created (Hunt 1979; Soots and Landin

1978). Precautions should also be taken so that gulls and terns would not be disturbed by construction of the dam and other facilities.

2.2.3 Upland Game Birds

Small breeding populations of California quail (Lophortyx californicus) and ring-necked pheasants (Phasianus colchicus, Figure 2.13) occur along the river especially in the shrub willows and remnants of abandoned orchards. These birds are not subjected to hunting pressure but a few birds are killed each year for radiological surveillance purposes (Houston and Blumer 1979). Larger pheasant populations are associated with the irrigated farmlands surrounding the Hanford Site. Quail populations are much larger in the brushy draws and ravines along the Snake River Canyon and in the foothills of the Blue Mountains. Sage grouse (Centrocercus urophasianus) formerly occupied habitats in the southern and western portions of the Hanford Site, gradually disappearing by the mid-1960's. A few sage grouse persist in the Rattlesnake Hills. A single covey of scaled quail (Callipepla squamata) was noted on the Wahluke Slope in 1956 (W. C. Hanson, Battelle personal communication). They have not been observed since.

In summer, mourning doves (Zenaida macroura) nest in trees in the dryland habitats bordering the Columbia River or on the ground on islands (Figure 2.14) and can be seen roosting in trees or foraging on the ground.

Dove nesting surveys conducted on all islands in the Hanford Reach of the Columbia River reveal that Islands 13, 14, 17, 18 and 19 were used for nesting. Of 23 nests observed since 1976, six were found on Island 17, six on Island 18, five on Island 19, three on Island 13 and three on Island 14 (R. E. Fitzner, Battelle unpublished). Doves nested on cobblestone substrate in four plant communities dominated by Eriogonum compositum, Artemisia absinthium, Lupinus sp. (Figure 2.15) and Chrysopsis sp. Vegetation with a vertical profile averaging 30 cm seemed to be preferred.

Doves begin to nest in late March and the first broods hatch in mid-April. Clutches of eggs have been observed in mid-May indicating that doves probably bring off more than one brood per year. The mid-May nests fledge young by early June. Tree nesting may go on after early June, but ground temperatures are too hot for island nesting.

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The dove is an important game bird in Washington, particularly in the eastern part of the state. Birds produced on Hanford cobblestone islands and along the shoreline are taken by hunters. Increasing conversion of native shrub-steppe habitat to farming (grains, alfalfa) is eliminating many historical nesting areas.

The Ben Franklin Dam alternative would inundate tree and shrub habitats, islands, and riparian areas important to game birds. Lewke and Buss (1977) found that birds forced from these kinds of habitats with the impoundment by Lower Granite Dam on the Snake River were not able to reestablish themselves in remaining above pool habitats which were filled to capacity before impoundment occurred. The greater a species depended on tree-shrub riparian or riverbank-flood plain habitat, the greater the impact of impoundment on that species. California quail are totally dependent upon riparian habitat during all seasons of the year and if this vegetation is cleared, quail populations will be lost (Lewke and Buss 1977). Pheasants are more closely tied to weedy fields along the Columbia River flood plain and would be forced to move into adjacent sagebrush-cheatgrass areas where their survival would be questionable. Doves are associated with riparian and cobblestone island habitats and nesting on these areas would be eliminated. Nesting would continue to occur in other habitats on the Hanford Site.

The Ben Franklin Dam alternative may positively benefit game birds in the long term if nesting cover and food develop with the new wetlands created by the dam (Wagner et al. 1965).

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2.2.4 Shorebirds

The long-billed curlew (Numenius americanus) nests on the Hanford Site in dry sagebrush-grass vegetation. The nesting birds apparently avoid streamside shrub-grass communities. However, birds that are produced on the Hanford Site congregate on islands in the Columbia River just before the onset of autumn migration (Fitzner, J. N. 1978). The principal areas used for nesting on the Hanford Site are cheatgrass fields containing some Poa species. Nesting in 1980 was observed in four major areas: (1) 100 H and 100 D from the 400 ft (122 m) contour to 3 miles inland; (2) from 100 F to the sand dunes within

3 miles of the river; (3) over a 2 mile radius about the WPPSS reactor; and (4) from 1 mile north to 1 mile south to 2 miles west of the 300 Area. The Hanford Site and adjoining Wahluke Slope support approximately 300 birds. The Hanford Site west of the river supports about 100 birds (Fitzner 1978). Another large curlew population breeds in sagebrush-grass vegetation near Boardman, Morrow Co., Oregon.

The northern killdeer plover (Charadrius vociferus) and the spotted sandpiper (Actitis macularia) regularly nest on the islands of the Hanford Reach and are primarily limited to islands dominated by cobblestone. Figure 2.16 shows a typical spotted sandpiper nest. In 1980, we surveyed all islands in the Hanford Reach for shorebirds and found killdeer plovers and spotted sandpipers nesting only on cobblestone islands. Killdeer occurred on Islands 1, 2, 3, 6, 9, 11, 12, 14, 15, 17, 18, 19 and 20, while spotted sandpiper nested on Islands 17 and 18 only. A pair of long-billed curlews nested on Island 12.

The Ben Franklin Dam alternative would inundate Islands 2 and 3, the principal staging areas for long-billed curlews on the Hanford Site (Fitzner 1980b). Many of the islands used for nesting by killdeer plovers would be inundated and Islands 17 and 18 used for nesting by spotted sandpipers may be subjected to frequent flooding, depending upon water outflow from the proposed dam.

The Ben Franklin Dam alternative would not likely benefit the shorebirds which presently nest on the Hanford Site. The close association of these birds with cobblestone islands and not with pond habitats on the Hanford Site (Fitzner and Rickard 1975) indicates that impoundment of the Hanford Reach would have a negative impact on curlews, killdeer and spotted sandpipers. Other species of shorebirds may benefit from impoundment, but data is lacking to substantiate this claim.

Mitigation measures should include exclusion of human disturbance from all known curlew nesting sites along the Hanford Reach.

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2.2.5 Birds of Prey

In order to determine the nesting species present and to gain some understanding of their relative abundance, studies of birds of prey residing on the Hanford Site were initiated in 1973 (Olendorff 1973). These initial studies were expanded to a comprehensive population study of the nesting birds of prey that live and interact together on the Hanford Site. Fitzner et al. (1980) described those continuing studies. Table 2.1 provides a taxonomic listing of all birds of prey that have been observed on the Hanford Site.

A single aerial survey for prairie and peregrine falcon nests was conducted on April 25, 1980 and encompassed all cliff habitats from Wanapum Dam downstream to Hanford townsite. (See Section 3.3.1.)

Six diurnal raptor species representing the Accipitridae have been recorded nesting on the Hanford Site. These include the marsh hawk (Circus cyaneus), ferruginous hawk (Buteo regalis), red-tailed hawk (Buteo jamaicensis), Swainson's hawk (Buteo swainsoni, Figure 2.17), prairie falcon (Falco mexicanus) and the American kestrel (Falco sparverius). These species, with the exception of the Swainson's hawk, have been recorded on the Hanford Site during every month of the year. Individuals seen during winter months however, may not be the same ones observed nesting. Eleven other diurnal raptors have been observed on the Hanford Site. The turkey vulture (Cathartes aura) is a rare springtime visitor. The goshawk (Accipiter gentilis), Cooper's hawk (A. cooperii) and sharp-shinned hawk (A. striatus) have been observed primarily in riparian habitats from September through January. The rough-legged hawk (Buteo lagopus) is chiefly a winter visitor, and nests further north in Canada and Alaska.

Five species of owls have been observed nesting on the Hanford Site. They include the great-horned owl (Bubo virginianus), long-eared owl (Asio otus, Figure 2.18), short-eared owl (Asio flammeus), barn owl (Tyto alba) and burrowing owl (Athene cunicularia). The great-horned and long-eared owls can be considered as permanent residents on the Hanford Site, while the others migrate to other areas during the winter. The snowy owl (Nyctea scandiaca) is an infrequent winter visitor while the screech owl (Otus asio), saw-whet owl

TABLE 2.1. Taxonomic Listing of the Birds of Prey of the Hanford Site

ORDER - FALCONIFORMES

Family - Cathartidae

Cathartes aura	Turkey vulture

Family - Accipitridae

Accipiter gentilis	Goshawk
A. cooperii	Cooper's hawk
A. striatus	Sharp-shinned hawk
Circus cyaneus	Marsh hawk
B. lagopus	Rough-legged hawk
B. regalis	Ferruginous hawk
B. jamaicensis	Red-tailed hawk
B. swainsoni	Swainson's hawk
Aquila chrysaetos	Golden eagle
Haliaeetus leucocephalus	Bald eagle
Pandion haliaetus	Osprey
Falco rusticolus	Gyrfalcon
F. mexicanus	Prairie falcon
F. peregrinus	Peregrine falcon
F. columbarius	Pigeon hawk
F. sparverius	American kestrel

ORDER - STRIGIFORMES

Family - Strigidae

Otus asio	Screech owl
O. flammeolus	Flammulated owl
Bubo virginianus	Great-horned owl
Asio otus	Long-eared owl
A. flammeus	Short-eared owl
Nyctea scandiaca	Snowy owl
Athene cunicularia	Burrowing owl
Aegolius acadicus	Saw-whet owl

Family - Tytonidae

Tyto alba	Barn owl

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(Aegolius acadicus) and flammulated owl (Otus flammeolus) are infrequent spring and summer visitors. The latter three species may nest on the Hanford Site but nests have not been reported.

Golden eagles (Aquila chrysaetos) have been observed during all months of the year though nesting on the Hanford Site has not been observed. Most spring and summer observations were of subadult birds; adults are usually not seen until fall or winter seasons. Bald eagles (Haliaeetus leucocephalus) use the Hanford Reach of the Columbia River every winter. A group of 15 to 20 individuals stay on the Hanford Site from late November until late January (Fitzner and Hanson 1979). Osprey (Pandion haliaetus) are uncommon visitors on the Hanford Site, but observations have been made during most months of the year. Gyrfalcons (Falco rusticolus) and peregrine falcons (Falco peregrinus) are rare winter visitors. During the course of this study, only one individual of each species was recorded. Pigeon hawks (Falco columbarius richardsonii and F. c. sukleyi) occur with irregularity on the site and all observations have been made during late fall.

The turkey vulture is a summer resident throughout Washington, but it seems to be more common on the east side of the Cascades (Hudson and Yocum 1954; Jewett et al. 1953; Alcorn 1971). On the Hanford Site observations have been limited to April 11, May 4 and May 25 of 1978. Single birds were recorded each time. On April 11, a turkey vulture was seen feeding on a road-killed black-tailed hare (J. N. Fitzner, personal communication 1978), while the May observations were of soaring birds on the east slope of Rattlesnake Mountain.

The turkey vulture is often mistaken as an eagle because of its large size and black plumage. Its bare head colored red-to-crimson is not characteristic of the eagles, however. The turkey vulture also has claws, feet and a bill which are much weaker than any of the other raptors found in Washington. These anatomical features are well adapted for feeding on carrion.

The goshawk occurs in Washington year-round. They nest in forested regions but move down to the lowlands in winter. This species has often been observed along the Yakima River, particularly in the Benton City area. On the

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Hanford Site it has been observed only during late fall and winter months (October through March). Most observations have been made at Snively Gulch, a wooded streamside on the Arid Lands Ecology Reserve (Figure 1.2). Goshawks have also been observed hunting over sagebrush-bluebunch wheatgrass communities (Fitzner et al. 1980).

Goshawks are well adapted for feeding on medium sized birds and mammals. This species is capable of capturing grouse and rabbits. Chukars, California quail and Nuttall's cottontail are probably the important prey species on the Hanford Site.

Cooper's hawks are usually observed in riparian habitats, particularly along the lower reaches of the Yakima River and at Snively Gulch on the Hanford Site. Records of sightings are available from September through March. Infrequent sightings have been made in shrub-steppe habitats.

Cooper's hawk feeds principally on birds of sparrow size, but will also feed on small mammals. White-crowned sparrows, mourning doves, and juncos have been recorded as prey on the Hanford Site (Fitzner et al. 1980).

The sharp-shinned hawk occurs in the Columbia Basin during fall, winter, and early spring chiefly in riparian areas, and is particularly abundant around the Benton City area in brushy sections adjacent to the Yakima River. One subadult bird was banded in Snively Gulch on September 5, 1978. Numerous sightings have been made in shrub-steppe and riparian habitats on the Hanford Site, particularly from September through March (Fitzner et al. 1980).

This small accipiter is 10 to 14 inches in length and has a wing spread of 20 to 27 inches. It feeds almost totally on small birds. No prey captures have been observed on the Hanford Site.

Marsh hawks can be observed at any time of the year in the Columbia Basin. The winter population may represent the same individuals that nest in the basin, but no data have been gathered to support this idea. Nesting occurs primarily in marshlands and in tall grassy fields. On the Hanford Site, the majority of nesting birds occur in Cold Creek Valley on the Arid Lands Ecology Reserve. This valley is densely vegetated with cheatgrass and tumble mustard. Several pairs of birds also nest in native bluebunch wheatgrass communities on

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the sideslope of Rattlesnake Mountain. Islands 6, 8, 13 and 16 (Hanson and Eberhardt 1971) have supported nesting marsh hawks in the past.

Marsh hawks feed on small mammals and birds. A female marsh hawk was observed killing a full grown Hungarian partridge (Perdix perdix) on the Hanford Site and marsh hawks have often been seen feeding on road-killed hares and rabbits (Fitzner et al. 1980).

The American rough-legged hawk is the most abundant buteo in the Columbia Basin during the winter. It has been observed in early April; May 1, 1979 is the latest springtime record. This bird was observed 2 miles (3.2 km) southwest of Kiona, Benton Co. Tremendous influxes of this hawk occur during the winter in the irrigated agricultural lands near Royal City in Grant Co.

American rough-legged hawks feed primarily on microtines while wintering in the Columbia Basin. Nearly 20 prey captures were observed during the 1970's and all were of microtines in alfalfa or grass fields. Alfalfa and grain fields apparently resemble tundra habitats and grasslands on which this raptor nests. Physical similarity of the wintering agricultural lands in the Columbia Basin with the rough-legged hawks' nesting habitat may, in part, explain the large wintering numbers of this species in southcentral Washington. The American rough-legged hawk does not nest in Washington, however. The added feature of an abundant prey base of microtines enhances the Columbia Basin hay fields for wintering because microtines are an important prey of the rough-legged hawks on their nesting grounds (Springer 1975).

The ferruginous hawk is one of the largest hawks nesting in the Columbia Basin and is uncommon. One nest is active on the Hanford Site. The presence of several old nests on Gable Butte and Rattlesnake Mountain indicate that others were present perhaps 10 or 20 years ago. Fitzner et al. (1977) estimated that in 1974-1975, about 20 pairs of these birds nested in Washington State, of which approximately half laid eggs, with the majority of the population occurring in Franklin Co. Another intensive survey conducted in 1978 indicated that the population consisted of 26 pairs, with 21 pairs having laid eggs. The areas surveyed in 1974 and 1975 were surveyed again in 1978. Either the population slightly increased during this time or some ferruginous hawks

went undetected in 1974-1975. Clearly the number of active nests, which infers that adults either laid eggs or hatched young or both, has increased nearly 100 percent.

The increase in ferruginous hawks in Washington in 1978 is perhaps a response to an increased prey base. In the 1978 nesting season, Townsend's and Washington ground squirrels (Spermophilus townsendii and S. washingtoni) were noticeably abundant. Grass cuttings, burrows, and squirrels were seen everywhere cheatgrass dominated a habitat. Observations at ferruginous hawk nests revealed that the hawks were feeding heavily on the squirrels. Field work in 1975 did not indicate any relationship between hawk production and ground squirrels. Other researchers (Howard and Wolfe 1976) indicate that ferruginous hawks are quite dependent on a healthy prey base of medium-sized mammals for production. Years of low-mammal densities have low ferruginous hawk productivity.

Ferruginous hawks nest on cliffs and trees and can even be found nesting on the ground. They occasionally build their nests low to the ground but usually build large stick nests on the crowns of trees.

The red-tailed hawk is perhaps the most frequently encountered large diurnal raptor in the Columbia Basin. It is the only large hawk commonly found nesting in irrigated farmland. Red-tailed hawks nest within a few hundred meters of houses and main roads, seeming only to require structure of suitable height for nesting. In over 50 nest sites examined in the past seven years, over 95 percent of all nests were found over 40 feet above ground. The taller the nesting structure, the more certain one can be of finding a pair of red-tailed hawks nesting in it. Lombardy poplars and cottonwoods tend to be the tallest of the trees found growing in the Columbia Basin and these form the bulk of the nesting structures. These hawks also nest in utility towers or on basalt and sandstone cliffs. Their ability to adapt to a wide variety of nesting structures enables them to exploit far more landscape than the more selective Swainson's and ferruginous hawks.

On the Hanford Site, red-tailed hawks nest mostly in utility towers (30-100 feet high), but several pairs nest on the Gable Butte complex, White Bluffs

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cliffs, and in the tallest trees from Hanford townsite upriver to the 100 D Area. They have been found nesting below the 400 ft (122 m) contour near the river.

Red-tailed hawks prey on a variety of organisms, but in the Columbia Basin they feed largely on lagomorphs, ground squirrels, and snakes. This hawk appears to be one of the few raptor species that eats rattlesnakes. During very hot periods (above 100°F), red-tailed hawks have been observed hunting --mostly during early morning and late evening. Rattlesnakes are active only during night time and twilight periods when ground temperature is lowest, unlike green racers and bullsnakes.

The Swainson's hawk is perhaps the most common of the three buteos that nest in the Columbia Basin. Between 15 and 18 pairs of Swainson's hawks nest on the Hanford Site (Fitzner 1980a). Nesting is restricted primarily to trees, however, and this limits the distribution of the species in areas dominated by rock outcroppings and cliffs. Trees available were planted by man for shade or fruit.

In the Columbia Basin, Swainson's hawks feed primarily on snakes (western yellow-bellied racer, gopher snake), occasionally eating rabbits, small mammals, birds and insects. This hawk is migratory and can be found in Washington from April to September. During the winter months the birds can be found in South America and sometimes in southern United States and Mexico. Swainson's hawks usually nest in low growing trees, 8 to 30 feet high. They construct a rather flimsy nest below the crown on a side branch (Fitzner 1980a).

The American kestrel is one of the most abundant nesting hawks in the Columbia Basin. Nests have been seen in trees along the Yakima River from Prosser to Richland and elsewhere where hollow trees, magpie nests, buildings or cliffs provide cavities for nesting. On the Hanford Site, nesting occurs principally on the White Bluffs, in trees along the Columbia River from Hanford townsite on the 100 D Area and in trees near Rattlesnake Springs, Benson Ranch, and Snively Gulch (Figure 1.3). Artificial nest boxes can be used quite effectively to increase the nesting densities of this species (Hamerstrom et al. 1973).

The small size of the kestrel limits the size of the prey organism on which it can feed. Small vertebrates (lizards, birds, mice) and insects form the diet of this species.

Two races of pigeon hawks have been observed on the Hanford Site, Falco columbarius suckleyi and F. c. richardsonii (Richardson's merlin), both present during October through early December. F. c. suckleyi is most often observed in the shelter belt area of Richland and along the lower reaches of the Yakima River. Neophyte bird watchers often mistake this bird for a peregrine falcon even though it is much smaller and colored somewhat differently. F. c. richardsonii is more likely to be seen in sagebrush-bunchgrass areas not far from riparian habitats. Neither of these two pigeon hawk races nests on the Hanford Site, although, F. c. richardsonii may nest in Franklin Co.

The small pigeon hawk is chiefly a bird feeder and is quite capable of capturing meadowlarks. Both races have been observed capturing small birds and a Richardson's merlin was seen feeding on a white crowned sparrow on one occasion.

The prairie falcon is perhaps one of the rarest of the nesting raptors on the Hanford Site. No more than four pairs have ever been found nesting on the Hanford Site during any one year. Olendorff (1973) felt that as many as seven pairs were present and that most of these occurred along Umtanum Ridge between Priest Rapids Dam and the Vernita bridge. During six years of intensive field investigation, three pairs were all that were ever located in that stretch of cliff line. The Gable Mountain-Gable Butte complex, White Bluffs, and Rattlesnake Mountain have also been used for nesting and are critical habitats for the nesting of prairie falcons on the Hanford Site. Prairie falcons are common in other areas of eastern Washington.

The habit of nesting on cliffs limits the spectrum of nest sites available to this raptor and hence limits the birds' distribution during the nesting season. The selection of cliff-nesting sites does, however, provide more protection for the eggs and young from natural predators and man than can be afforded to the tree-nesting raptors. Unless efforts are taken to assure that the few cliff nesting sites are protected from human disturbances, this raptor may disappear from the Hanford Site.

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Prairie falcons feed on a variety of small mammals and birds, particularly pocket gophers and cottontail rabbits. The abundant prey resources available on the Hanford Site do not appear to be a limiting factor in the size of the present breeding population. The breeding population probably could be enhanced through the creation of suitable nest cavities on cliffs where none exist, particularly on White Bluffs and Rattlesnake Mountain.

The American osprey has not been recorded nesting in the Columbia Basin; however, sightings of adult birds during the breeding season are not uncommon. A lack of suitable nest sites and/or prey base could be important reasons for the American osprey's absence as a nesting species. During July and August, sightings of American ospreys become more prevalent and as fall approaches, American ospreys are rather common along the Columbia, Snake and Yakima Rivers of the Columbia Basin. Observations have also been made during the winter and early spring months. Most sightings on the Hanford Site occurred within 2 km of the Columbia River.

More than 20 ospreys have been observed feeding on prey along the Hanford Reach. In all cases, fish were the only organsisms eaten. Suckers appeared to comprise the major part of the osprey's diet.

Golden eagles are present year-round on the Hanford Site, but nesting occurs in adjacent areas where high cliffs are present. Artificial nesting structures placed on Rattlesnake Mountain might induce eagles to nest. Most golden eagle sightings were made on the Hanford Site from late fall to early March and most were of juvenile birds. Two areas most heavily used by the golden eagles are the Arid Lands Ecology Reserve and the lands between the 300 Area and Hanford townsite extending from the Columbia River inland about 3 miles. Approximately eight to ten golden eagles winter on the Hanford Site. Little is known about daily or seasonal movements of these birds.

Golden eagles are principally medium-sized mammal consumers, feeding heavily on black-tailed hares. They have been observed feeding on road-killed deer and rabbits and have also been seen capturing hares and robbing food (snakes) from young nestling Swainson's hawks.

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Bald eagles occur in the Columbia Basin and on the Hanford Site mostly during winter months. They are found near waterways, particularly along the Hanford Reach of the Columbia River.

Employing ground observations and aerial flights, Fitzner and Hanson (1979) showed that the number of wintering bald eagles using the Hanford Reach has increased from about six birds in the 1960's to 20 birds at the present time. No data is available for the Hanford Site on daily or seasonal movement patterns of this species. Nesting was reported for the Hanford Site during the 1960's, but no birds have nested here since that time.

Eagles are attracted to the Columbia River because of salmon carcasses washed ashore from spawning beds scattered along the Hanford Reach (Watson 1978). Although salmon carcasses provide an important dietary item, eagles also prey upon hunter-wounded waterfowl.

The Hanford population of wintering eagles is small compared to wintering populations in western Washington. The Nooksack River population is estimated at 100 birds (Stalmaster et al. 1978). It seems likely that in the absence of human harassment bald eagles will continue to use the Hanford Reach as long as salmon carcasses remain available as a food source.

Bald eagles are quite dependent on fish for their food. Waterfowl, rabbits, and carrion also may become important seasonally, but fish seem to be preferred when available (Fitzner and Hanson 1979).

There are no sight records for the screech owl from the Hanford Site; however, two adults have been observed near Benton City. The birds (observed on different occasions) were associated with farming lands interspersed with groves of deciduous trees planted by man or occurring naturally along the banks of the Yakima River. The bird is probably not as uncommon as records indicate.

Screech owls nest mostly in cavities of trees, but readily accept artificial nest boxes (VanCamp and Henny 1975). The diet of this species consists mostly of small mammals and birds (Smith and Wilson 1971).

The great-horned owl is not abundant on the Hanford Site due to a scarcity of heavily wooded habitats and cliffs. When these habitats are present, the

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birds can usually be found. Great-horned owls have been found using riparian canyons on the slopes of Rattlesnake Mountain, wooded areas along the Columbia River from Hanford townsite upstream to the Vernita bridge, on Gable Butte and White Bluffs and retired buildings associated with the 100 Areas. Other areas of the Columbia Basin where great-horned owls commonly occur are wooded banks of the Yakima River; the Juniper Forest in southern Franklin Co.; and cliffs along the Snake and Columbia Rivers and in the Channeled Scablands (U.S. Department of the Interior 1973).

When these large owls were first studied on the Hanford Site, their numbers seemed to be increasing. Since 1976, the population of 12 birds has dropped to seven in 1978. The number of nesting pairs has also declined from five to three pairs. This reduction appears to be directly related to human disturbance. A pair that often used the 100 D Area buildings for roosting and nesting may have been driven away by decommissioning activities along the Columbia River near that area. Decommissioning activities elsewhere along the Columbia River may also have disturbed other great-horned owls. A DOE-supported sign project has been enacted in an effort to alert workmen and others to sensitive wildlife areas where offroad travel and disturbance to wildlife are prohibited.

Great-horned owls feed on a variety of prey organisms and seem to be capable of capturing animals ranging in size from jackrabbits to insects. On a numerical basis, the Great Basin pocket mouse was frequently captured, but lagomorphs were of greater importance on a biomass basis.

On the Hanford Site, long-eared owls occur only in areas where trees are present. Abandoned orchards, homesteads, and the Hanford townsite are the primary use areas for nesting and roosting, with Snively Canyon and Rattlesnake Springs on the Arid Lands Ecology Reserve also receiving some use. Here again is a species which has particularly benefited from man's planting of trees. In pre-Caucasian times, trees were no doubt scarce in the Hanford area and long-eared owls were limited to natural riparian habitats. Long-eared owls occur throughout the Columbia Basin wherever trees occur and man's activities

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are minimized or absent. The Yakima delta area of Richland and the juniper forest of southern Franklin Co. are heavily used for nesting and roosting by this owl.

Over 90 percent of this owl's diet consists of pocket mice and deer mice with pocket mice forming the bulk of the diet.

The short-eared owl is a common winter visitor in the Columbia Basin, but is an uncommon breeding species. Marshlands, irrigated pasture lands and alfalfa fields are common nesting habitats in the basin. During the winters of 1973, 1975 and 1977, short-eared owls were very abundant in farmlands from Vantage to Othello. Tremendous influxes of short-eared owls occur during the winter in the agricultural lands near Royal City in Grant Co. The marshes and alfalfa fields which abound in this area support high populations of microtines. These form an important component of the short-eared owl's diet (Fitzner and Fitzner 1975). The Hanford Site does not support many wintering or nesting short-eared owls. Pristine habitats do not seem to attract this species as well as farm lands and marshes. Again, this is probably related to the availability of prey (mostly microtines), but could also be related to the structure of vegetational associations. Wintering birds may be attracted to areas which resemble tundra. Many of these wintering short-eared owls are probably birds which nested far north in Canadian trundra and in moving south during winter, they naturally select habitats which resemble areas they have previously experienced.

The short-eared owl is primarily diurnal as are microtines. Fitzner and Fitzner (1975) found that this owl feeds heavily on microtines and also consumes some deer mice. Small prey mammals are selected roughly in the same frequency as they occur in the environment.

Barn owls are common in the Columbia Basin and should be considered a year-round resident. An influx of birds may occur in the spring as a migrant group returns to breed. This species has been found nesting on basalt cliffs, in old barns, buildings, hay stacks, and in magpie nests, and has been observed at all seasons of the year.

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On the Hanford Site, barn owls are most often seen around the 100 Areas in old buildings and in reactor outflows along the Columbia River. Rattlesnake Springs is often used by the species. Between two and four pairs reside on the Hanford Site.

Barn owls, like long-eared owls, are almost totally mouse hunters. In pristine shrub-steppe habitats, they feed mostly on Great Basin pocket mice. In farmlands, the house mouse replaces the pocket mouse as the major prey species. Unlike the long-eared owl, barn owls were not found to feed on insects, and their diet was also more restricted in diversity of prey.

The flammulated owl is uncommon in the Columbia Basin but occurs as a summer resident in the Blue Mountains (Hudson and Yocom 1954). Only one record exists for the Hanford Site on March 5, 1972. A single bird was observed in a rocky gulch near Bobcat Canyon on the sideslopes of Rattlesnake Mountain. Flammulated owls are probably more abundant than records indicate since they are rather secretive and cryptically colored. In the Columbia Basin the species is probably a migrant.

This small dark-eyed owl nests in cavities of trees or stumps in wooded and brushy areas.

In the Columbia Basin, the saw-whet owl is probably a common migrant in riparian areas and juniper habitats. An adult saw-whet owl was banded on July 17, 1978 at Snively Canyon on the sideslopes of Rattlesnake Mountain. Hudson and Yocom (1954) also report a breeding record for nearby Dayton in Columbia Co.

The saw-whet owl is primarily a forest dweller where it feeds on small mammals (microtines, Peromyscus, Sorex) and small birds (Forsman and Maser 1970).

Snowy owls nest in the arctic regions of North America, but incursions into Washington and the Columbia Basin have been reported (Hanson 1971). During this study, few records were reported for the Columbia Basin. One or two reports of large white owls occurred each winter but there was no large influx

of birds as reported by Hanson (1971). The only record for the Hanford Site since 1973 was a single bird on top of Rattlesnake Mountain in January of 1974 (Rotenberry, Battelle unpublished).

This species feeds on a variety of small mammals, birds, and lagomorphs. In the arctic, lemmings, ptarmigan, and snowshoe hares are important prey. An examination of castings collected near Pullman, Washington showed Microtus montanus to be the major prey item.

The burrowing owl is perhaps the most abundant owl nesting in the Columbia Basin and is certainly the most common owl nesting on the Hanford Site. Between 20 and 26 nesting pairs occur on the Hanford Site. Badger (Taxidea taxus) and coyote (Canis latrans) burrows provide most of the nest sites. This species has been observed wintering around Benton City and Mattawa and at least one pair has been observed near Benton City every winter since 1973. These birds used a badger hole for shelter. Woodby (1976) reports on several other winter records for burrowing owls in eastern Washington.

Burrowing owls feed on insects and small mammals, taking a larger number and greater diversity of insects than mammals. Mammals, however, form the bulk of their diet on a biomass basis.

Impact of Ben Franklin Dam Alternative on Hanford Birds of Prey. Birds of prey have received considerable attention in recent years because of their sensitivity to environmental contaminants (Peakall 1976; Fyfe et al. 1976) and disturbance by humans (Fyfe and Olendorff 1976). The impacts of energy developments on raptors were also the theme of a workshop held in Boise Idaho in 1979 (Howard and Gore 1980). This workshop addressed power line impacts on raptors and mitigation measures.

The Ben Franklin Dam alternative can be expected to affect several raptor species in a negative fashion, primarily through the elimination of their nest sites and hunting areas. Three or four pairs of Swainson's hawks, two to three pairs of red-tailed hawks, five to six pairs of American kestrels, six to eight pairs of marsh hawks, six to eight pairs of long-eared owls, eight to nine pairs of burrowing owls, two to three pairs of great horned owls, two pairs of short-eared owls, and two to three pairs of barn owls would be displaced from

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their nest sites. Golden and bald eagles and ospreys would lose valuable foraging areas and roosting sites. Few raptor species would benefit from the Ben Franklin Dam alternative.

Mitigation for the loss of nest sites and habitat could include a number of options: vegetation manipulation, maintenance of existing raptor habitat above the 400 foot contour, aquisition of raptor habitat, restrictions of human use on raptor nesting and roosting areas, and artificial nest structures (Call 1979; Olendorff and Stoddart 1974; Dunston and Borth 1970; Fitzner 1980b).

2.2.6 Passerine Birds

There have been no studies specifically designed to census the bird populations associated with shoreline tree/shrub communities of the Hanford Reach. However, bird surveys have been conducted in riparian communities with similar plant species composition and general external appearance on the Hanford Site (Rotenberry et al. 1979, Table 2.2) and along the Snake River Canyon (Lewke and Buss 1977). Fitzner and Rickard (1975) surveyed birds in riparian communities associated with waste ponds on the Hanford Site and winter bird populations have been censused in tree communities along the Yakima River flood plain at Richland, Washington (Rickard and Rickard 1972). Although it is reasonable to expect similar bird species composition in Columbia River tree/shrub communities as other tree/shrub riparian communities, more accurate counts are needed to estimate bird utilization in Columbia River shoreline communities. A survey conducted in six habitats associated with the Columbia River during this study provides additional data on birds of the Hanford Reach. Ravens, Corvus corax, occasionally nest on the face of steep bluffs.

Table 2.3 provides a listing of all birds observed in six major habitats associated with the Hanford Reach. These habitats, located within the 400 ft (122 m) contour of the Hanford Reach (Figure 1.2), were surveyed in April, May and August, 1980 for three consecutive days each month to obtain data on the birds present. A total of 54 bird species were observed in all habitats combined. The riparian habitat had 33 bird sightings with island and wooded habitats having the next most numerous sightings, 21 and 20 species respectively.

Further research is recommended to further define seasonal occurrance and habitat use by these bird species. The mourning dove was observed in all six habitats, while 27 bird species occurred exclusively in one habitat type. Table 2.3 illustrates the importance of each habitat to a community of birds and also exemplifies the habitat tolerance limits of each species. Those species then that occur in only one habitat may represent the least adaptable organisms. If the species' richness and diversity present now is to be maintained in the Hanford Reach, then habitat diversity must also be maintained.

The Ben Franklin Dam alternative is expected to reduce the richness and diversity of bird species along the Hanford Reach. Species which occur in one or a few habitats (see Table 2.3) will have low tolerances for change and thus may be displaced or eliminated from the Hanford Reach if impoundment occurs.

Lewke and Buss (1977) pointed out that birds forced from habitats by inundation would not be able to reestablish themselves in remaining above-pool habitats which were filled to capacity before impoundment occurred. The same can be expected on the Hanford Site. They also stated that the greater the dependence of a species on tree-shrub riparian or river bank-flood plain habitat, the greater the impact of impoundment on that species. Riparian, island, wooded, and sand dune habitats are mostly limited to the area below the 400 ft (122 m) contour in the Hanford Reach, and thus the birds using them now (see Table 2.3) would be impacted most.

Certain mitigation practices could be implemented to improve opportunities for some bird species to use areas impacted by the Ben Franklin Dam alternative. New habitats could be developed by planting trees and other vegetation beneficial to wildlife species. Islands, if properly constructed, could also benefit wildlife (Coastal Zone Resources Division 1978; Hunt 1979). Much research would need to be done to determine the precise habitat requirements of many species and the outcome of any mitigation measures. The original diversity of birds would not be obtainable through mitigation measures.

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TABLE 2.2. Most Abundant Birds Recorded in a Riparian Tree-Shrub Community (modified from Rotenberry et al. 1979).

Breeding Birds		Wintering Birds	
Mourning dove *Zenaida macroura*	28.5 (11)	Dark-eyed junco *Junco hymenalis*	26.5 (9)
Chukar *Alectoris chukar*	20.7 (9)	Yellow-rumped warbler *Dendroica coronata*	4.7 (2)
Western meadowlark *Sturnella neglecta*	19.4 (11)	Western meadowlark *Sturnella neglecta*	3.7 (5)
Barn swallow *Hirundo rustica*	8.9 (11)	American robin *Turdus migratorius*	2.6 (6)
Northern oriole *Icterus galbula*	7.6 (10)	Black-billed magpie *Pica pica*	2.2 (8)
Vesper sparrow *Pooecetes gramineus*	7.4 (7)	White-crowned sparrow *Zonotrichia leucophrys*	1.8 (5)
Starling *Sturnus vulgaris*	5.6 (5)	Ring-necked pheasant *Phasianus colchicus*	1.7 (5)
Lazuli bunting *Passerina amoena*	5.5 (10)	Song sparrow *Melospiza melodia*	1.6 (7)
Black-billed magpie *Pica pica*	5.2 (10)	California quail *Lophortyx californicus*	1.5 (1)
Wilson's warbler *Wilsonia pusilla*	3.7 (4)	Ruby-crowned kinglet *Regulus calendula*	1.2 (6)
Brewer's blackbird *Euphagus cyanocephalus*	2.8 (6)	20 other species	10.2 -
Eastern kingbird *Tyrannus tyrannus*	1.9 (5)	Other species: Golden eagle, Red-tailed hawk, Goshawk, Cooper's hawk, Rough-legged hawk, Swainson's hawk, Pigeon hawk, Long-eared owl, Raven, Loggerhead shrike, Northern shrike, Killdeer, Red-winged blackbird, Tree swallow, Night hawk, Black-headed grosbeak, Vesper sparrow, Savannah sparrow, Lark sparrow, Rufous-sided towhee, Sage sparrow, Golden-crowned sparrow, Slate-colored junco, Western kingbird, Say's phoebe, Trails' flycatcher, Western wood pewee, Dusky flycatcher, Rock wren, Canyon wren, Winter wren, House wren, Long-billed marsh wren, Red-shafted flicker, Golden-crowned kinglet, Red-eyed vireo, Warbling vireo, Warbling vireo Solitary vireo, Nashville warbler, Yellow warbler, Townsend's warbler, McGillray's warbler, Varied thrush, Hermit thrush, Townsend solitaire, Rufous hummingbird.	
California quail *Lophortyx californicus*	1.8 (6)		
Western tanager *Piranga lusdoviciana*	1.5 (5)		
Song sparrow *Melospiza melodia*	1.4 (7)		
Sage grouse *Centrocercus urophasianus*	1.4 (2)		
Yellow-breasted chat *Icteria virens*	1.1 (6)		
Brown-headed cowbird *Molothrus ater*	1.1 (3)		
White-crowned sparrow *Zonotrichia lencophrys*	1.0 (1)		
Kestrel *Falco sparverius*	1.0 (7)		
Rock wren *Salpinctes vulgaris*	1.0 (7)		
38 other species	12.1 -		

(a) Values are average number of individuals seen in 11 breeding seasons (May-August) and in 10 wintering seasons (November - March) counts. Actual counts in which each species was observed is in parentheses.

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TABLE 2.3. Bird Species Associated with the Hanford Reach of the Columbia River, April - August 1980*

Bird Species	Habitat						No. Habitats Used
	Riparian	Island	Wooded	Sand dune/ Bitterbrush	Sagebrush	Cheatgrass	
White Pelican		X					1
Canada Goose	X	X					2
Mallard	X	X					2
Pintail	X	X					2
Green-Winged Teal	X						1
Common Merganser	X	X					2
Marsh Hawk	X	X		X	X	X	5
Swainson's Hawk	X		X	X	X	X	5
Red-Tailed Hawk	X		X	X	X	X	5
American Kestrel	X		X	X			3
California Quail	X		X				2
Ring-Necked Pheasant	X	X	X				3
Great Blue Heron	X	X					2
American Coot	X						1
Killdeer	X	X					2
Long-Billed Curlew	X	X		X	X	X	5
Spotted Sandpiper		X					1
Common Snipe	X						1
California Gull	X	X					2
Ring-Billed Gull	X	X			X	X	4
Forester's Tern	X	X					2
Caspian Tern		X					1
Mourning Dove	X	X	X	X	X	X	6
Rock Dove	X						1
Long-Eared Owl			X				1
Barn Owl			X				1
Common Nighthawk	X		X	X	X	X	5
Belted Kingfisher	X						1
Red-Shafted Flicker			X				1
Eastern Kingbird	X						1
Western Kingbird			X	X	X	X	4
Say's Phoebe			X				1
Horned Lark		X		X	X	X	4
Barn Swallow	X						1
Cliff Swallow	X	X					2
Rough-Winged Swallow	X						1
Black-Billed Magpie	X	X	X	X	X	X	6
Common Raven			X	X	X	X	4
Robin	X						1
Loggerhead Shrike			X				1
Starling			X				1
Yellow-Rumped Warbler			X				1
Townsend's Warbler			X				1
Western Meadowlark	X			X	X	X	4
House Sparrow			X				1
Yellow-Headed Blackbird	X						1
Red-Winged Blackbird	X						1
Brewer's Blackbird		X		X			2
Northern Oriole			X				1
Western Tanager			X				1
Savannah Sparrow		X					1
Lark Sparrow				X	X		2
Sage Sparrow				X	X		2
Song Sparrow	X						1
TOTAL SPECIES	33	21	20	16	14	12	

* X indicates presence

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2.3 MAMMALS

2.3.1 Deer

The mule deer (Odocoileus hemionus, Figure 2.19) is the most numerous big game animal on the Hanford Site. Occasionally a white-tailed deer (Odocoileus virginianus) is observed on the Hanford Site (O'Farrell and Hedlund 1972). The islands and riparian plant communities along the Hanford Reach of the Columbia River provide fawning habitat for the mule deer. Eberhardt et al. (1979) summarized information about Hanford deer populations. Hedlund (1975) reported that mule deer tagged as fawns were hunter-killed at points as far as 100 km from their point of capture. A few deer are killed each year by automobile traffic on Hanford Site highways and samples of tissues are taken for radiological surveillance purposes (Houston and Blumer, 1979).

The existence of the mule deer population at Hanford hinges upon two important factors. First, hunting is not permitted. Second, the land use of the Hanford Site is non-agricultural, allowing deer to forage without incurring crop damage claims by land owners and encouraging the Washington Game Department to keep the herd size as small as practical. The Hanford mule deer population is isolated from larger deer populations in the Blue Mountains to the east and the Cascade Mountains to the west and from the Snake River Canyon population by many miles of intervening farmland. A few mule deer reside in the Rattlesnake Hills but it is not known if this small population is interchangeable with the larger deer population along the Columbia River.

The mule deer herd on the Hanford Site may not be as healthy as other populations. Steigers (1978) stated that the daily movements of radiotelemetered fawns on the Hanford Site were greater than those of fawns at other locations. This may be an indication that parent deer have to travel further to obtain their daily dietary requirements. Eberhardt et al. (1979) examined six years of fawn tagging records from the Hanford Site. These data showed a decline in the number of fawns tagged in the last three years or record. The decline suggests that there are fewer females to produce fawns, that fawn predation has become more pronounced, or that fawning occurs elsewhere. Tagging operations conducted mostly on islands also may have disturbed the deer and as a result, fawning may be displaced to inland areas.

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It is apparent from general observation that summer browse plants on the Hanford Site are scarce and that the few available trees are being utilized to their very maximum. Inadequate summer browse might contribute to a decline in the general health and productivity of a deer population. However, there is no information concerning total numbers, sex ratios, average weights, or age distribution of the Hanford mule deer herd.

The most conspicuous plants along the Hanford Reach of the Columbia River are a few aged trees planted for shade and as ornamentals around farmsteads in the years prior to 1943. These are mostly Chinese elm, black locust, lombardy poplar, white poplar, eastern cottonwood and mulberry. At a few places some fruit trees still survive, especially apricots.

Mulberry, Russian olive, cottonwood and peach-leaf willow are agressive enough to establish seedlings at favorable microsites in the riparian zone. Tree foliage provides a forage source for mule deer and porcupine (Erethizon dorsatum, Figure 2.20). Mule deer eat the leaves hanging within their reach. Trees provide pools of shade which are actively sought by mule deer during the hot, sunny summer months. Nearly all the trees along the western bank of the Columbia River show browse-lines created by deer. Volunteer mulberry trees on the western shore are severely pruned by mule deer but trees on the eastern shore are relatively untouched. This is attributed to the fact that most of the deer population is confined to the western shore under the protective umbrella provided by the Hanford Site.

The Ben Franklin Dam alternative would inundate 14 islands used for fawning by mule deer. The seclusion of these islands and general lack of predators has been important in the production of the Hanford deer population (Hedlund 1975). Riparian and wooded habitat used for cover, food and fawning would also be lost. The impact on deer populations in the Columbia Basin is dependent on the population dynamics and behavior of other herds. While studies are underway, insufficient information is available for full analysis at this time.

Mitigation measures could include creation of new islands, predator control and habitat management through vegetation manipulation, land acquisition and managing human disturbances.

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2.3.2 Fur Bearers

Coyotes (Canis latrans) are important predators of mule deer fawns on the Hanford Site (Steigers and Flinders 1980). Although the Columbia River is not an impossible barrier to coyote movement, radiotracking studies showed that tagged coyotes spent a great deal of their time within a distance of a few kilometers of the river (Springer 1977). There is no estimate of the size of the Hanford Site coyote population but it is probably greater than in the surrounding farmlands. About 700 coyotes were removed from Hanford and surrounding environments each year from 1950 to 1970 by the U.S. Fish and Wildlife Service (Hanson and Eberhardt 1971). Coyote trapping is practiced as a source of income and as a recreational endeavor around the periphery of the Hanford Site.

Beaver (Castor canadensis), muskrat (Ondatra zibethica) and mink (Mustela vison) occur along the Columbia River. There is no estimate of their abundance. The most suitable slack water habitats are in the vicinity of Ringold Springs, Jap Slough, Hanford Slough, 100 F Slough and White Bluffs Slough. Other fur bearing mammals that occur along the river but for which there is no specific information are raccoon (Procyon lotor), skunk (Mephitis mephitis), weasels (Mustela frenata and M. erminea) and bobcat (Lynx rufus).

Fur bearers may increase as a result of the Ben Franklin Dam alternative. Impoundment would in time create new wetland habitats favorable to beaver and muskrat, raccoon, skunk, weasel and coyote. Bobcat response is uncertain. Aquatic emergent and submergent plants are expected to provide food for muskrats. Eventually, willows will invade some shoreline areas, providing food for beaver. Coyotes are very mobile and could seek prey in other areas.

2.3.3 Small Mammals

Small mammals occur in the riparian plant communities along the shore of the Columbia River although there have been no specific studies made to determine species' composition or their relative abundance. Deer mice (Peromyscus maniculatus), house mice (Mus musculus), vagrant shrews (Sorex vagrans) and montane meadow mice (Microtus montanus) are present. The Columbia River is well known as a barrier to the dispersal of Ord's kangaroo rat (Dipodomys

ordii) and the Washington ground squirrel (Spermophilus washingtoni). Both of these species occur on the east bank of the river but not on the west bank. Preliminary data indicate that some of the islands harbor these species, and it is expected that these small mammals may eventually colonize the west bank in suitable habitats. Bushytail woodrats (Neotoma cinerea) occur in abandoned buildings and in trees planted by former occupants of the Hanford Site.

2.3.4 Hares and Rabbits

Black-tailed hares (Lepus californicus) occur throughout the undeveloped sagebrush-grass vegetation along the Columbia River, but these animals are not dependent upon riparian vegetation for their existence. Cottontails (Sylvilagus nuttallii) seem to prefer edge habitats where riparian tree/shrub communities adjoin sagebrush-grass communities. There have been no studies made to estimate the abundance of cottontails along the Hanford Reach.

Small mammals, hares and rabbits would be impacted by the Ben Franklin Dam alternative because of species saturation and terratorial compression (Lewke and Buss 1977). This loss of mammals will have a negative impact on predators through an overall reduction in prey resources. In time, impoundment may provide new riparian habitat for some small mammal species, though little is known about small mammal population dynamics within the Snake and Columbia River basins.

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9 2 1 2 3 7 1 9 7 5

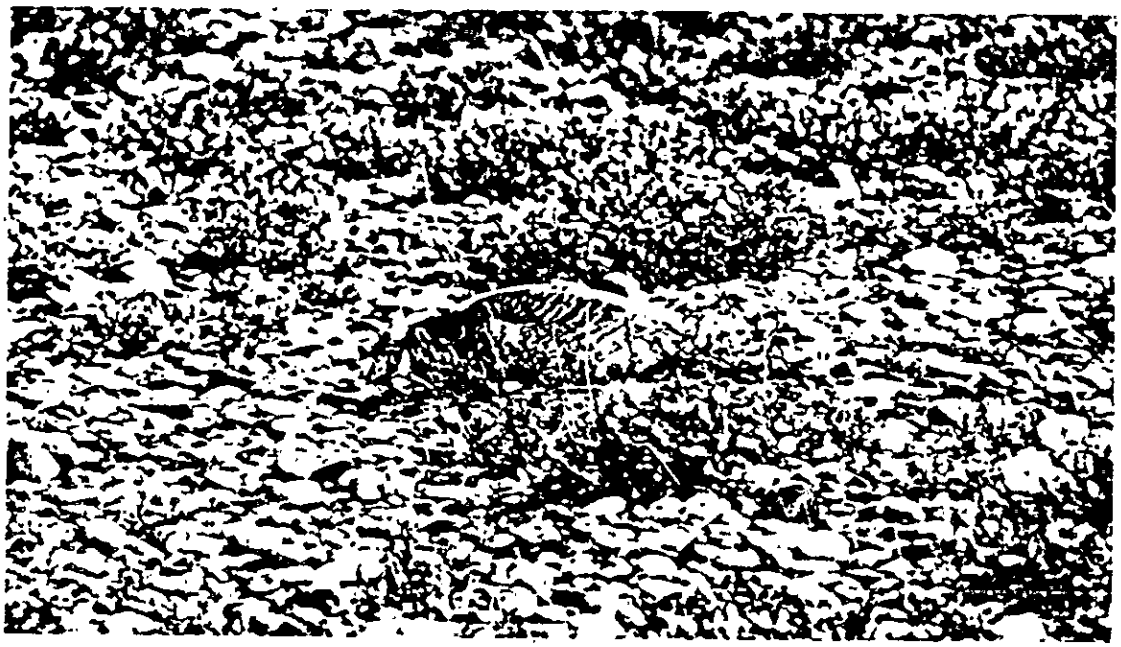

FIGURE 2.1. Canada goose nesting in cobblestone habitat.

FIGURE 2.2. Sand and clay bluffs bordering the Columbia River on the east.

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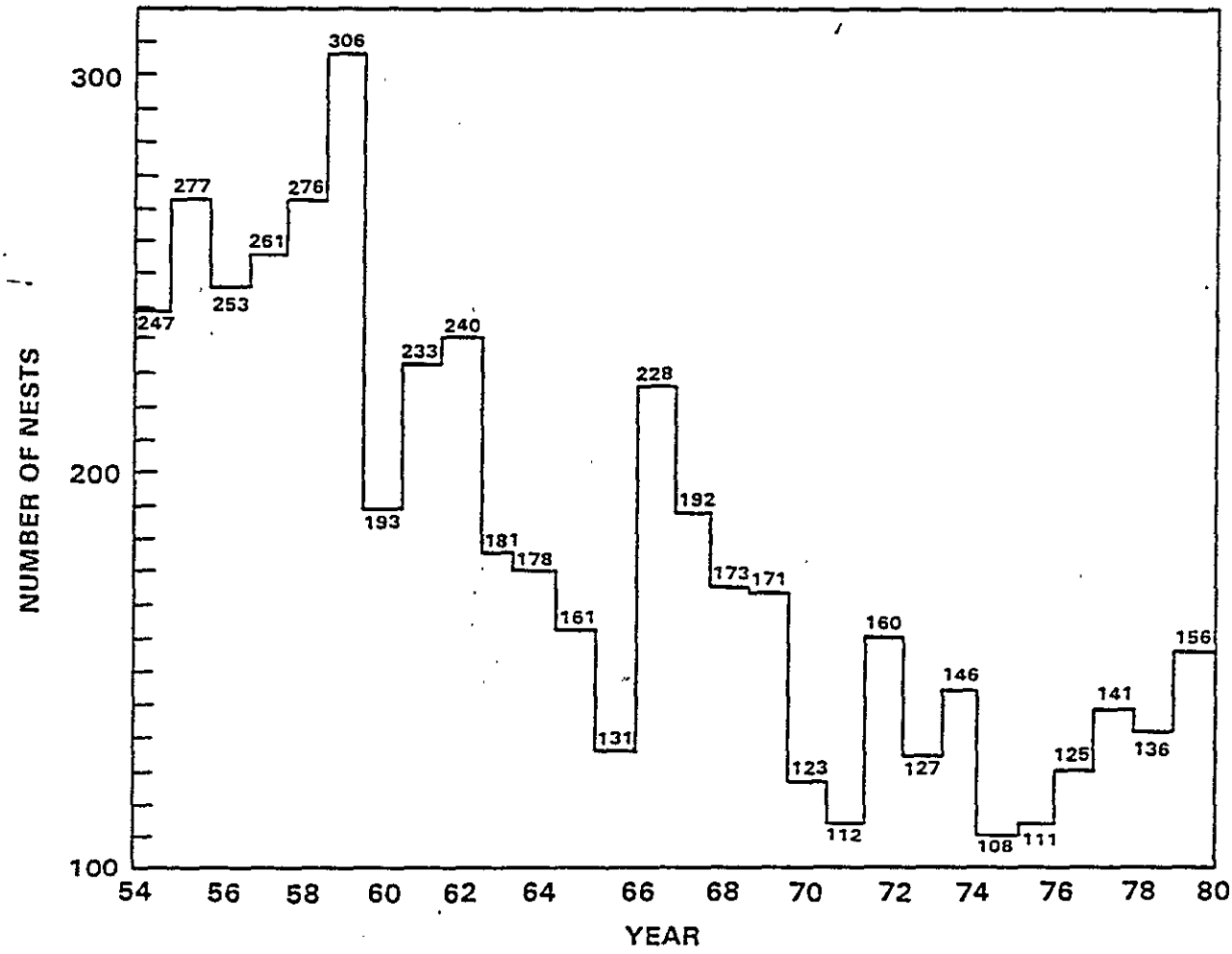

FIGURE 2.3. Numbers of Goose Nests Found on Columbia River Islands, 1954–1980

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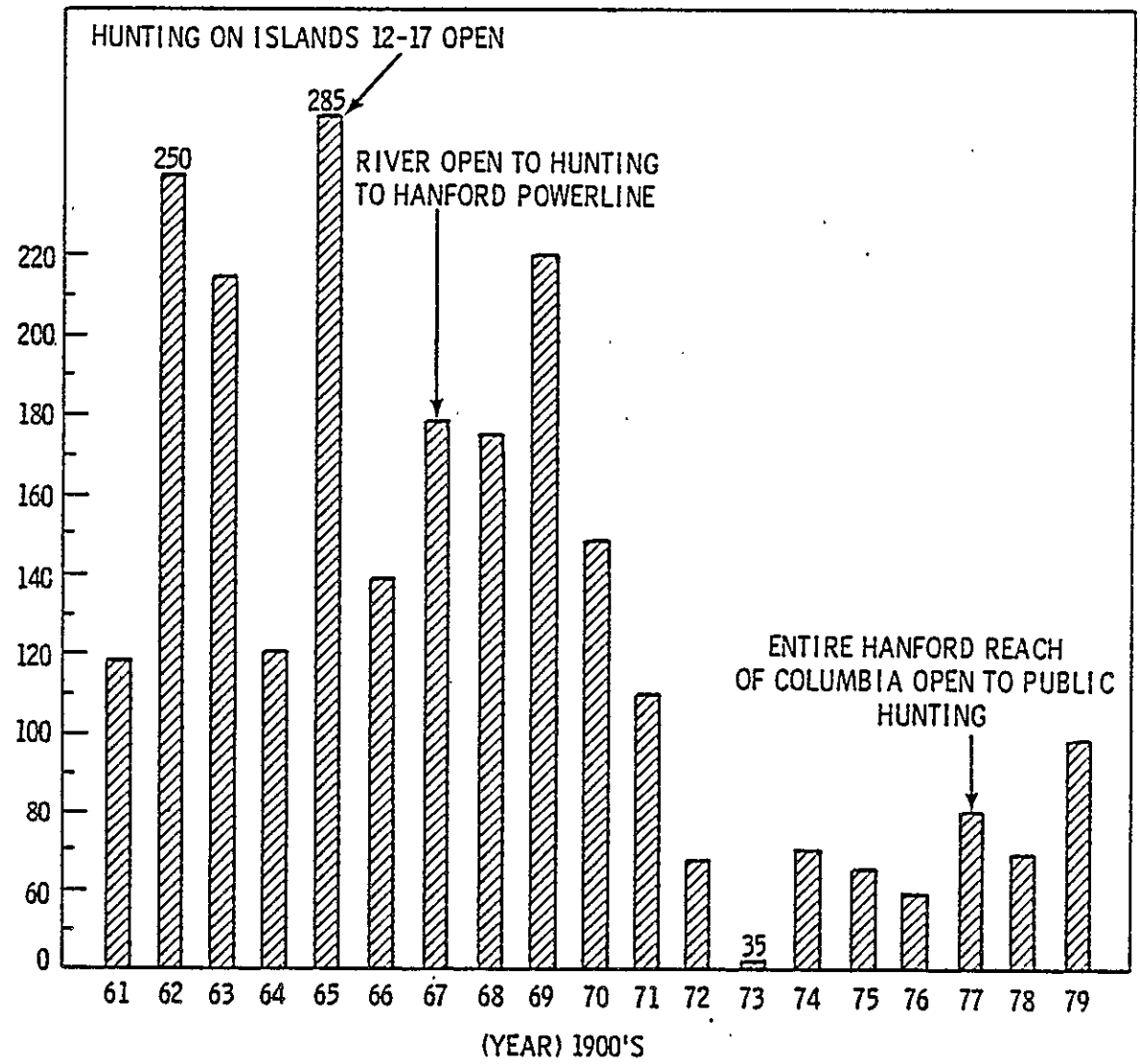

FIGURE 2.4. Mallard Population Maxima for 1961-1979

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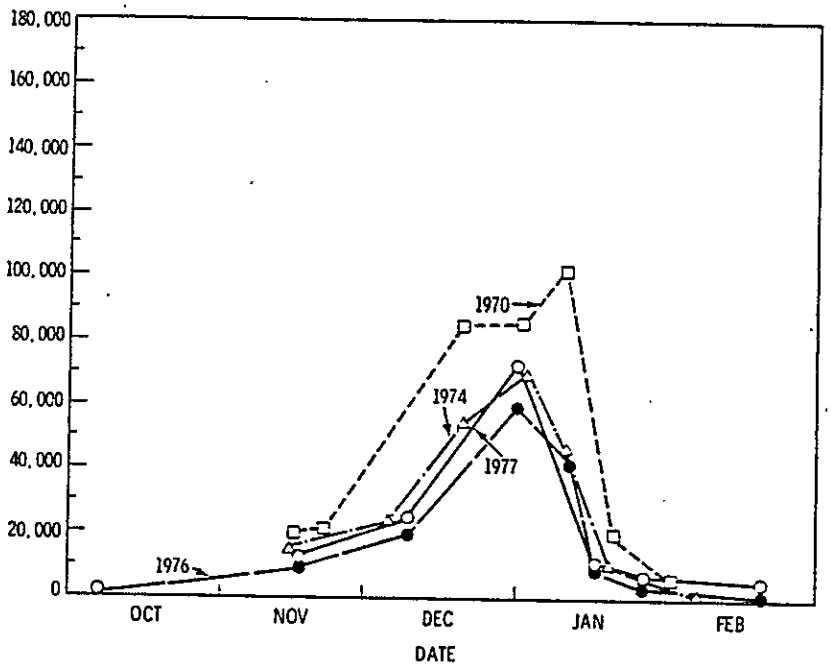

FIGURE 2.5. Winter use of the Hanford Reach by mallards during the early 1970's.

FIGURE 2.6. Mallard nest in a patch of ryegrass.

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FIGURE 2.7. A typical clump of dense vegetation used for nesting by mallards.

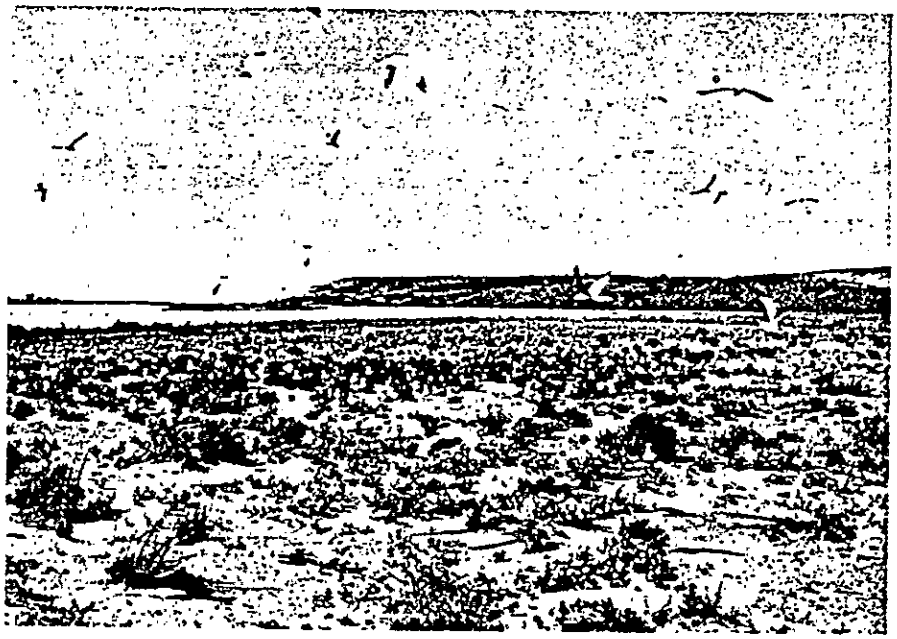

FIGURE 2.8. Mixed colony of California and ring-billed gulls on Island 20.

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FIGURE 2.9. Ring-billed gulls, nesting on Island 12 in cobble substrate

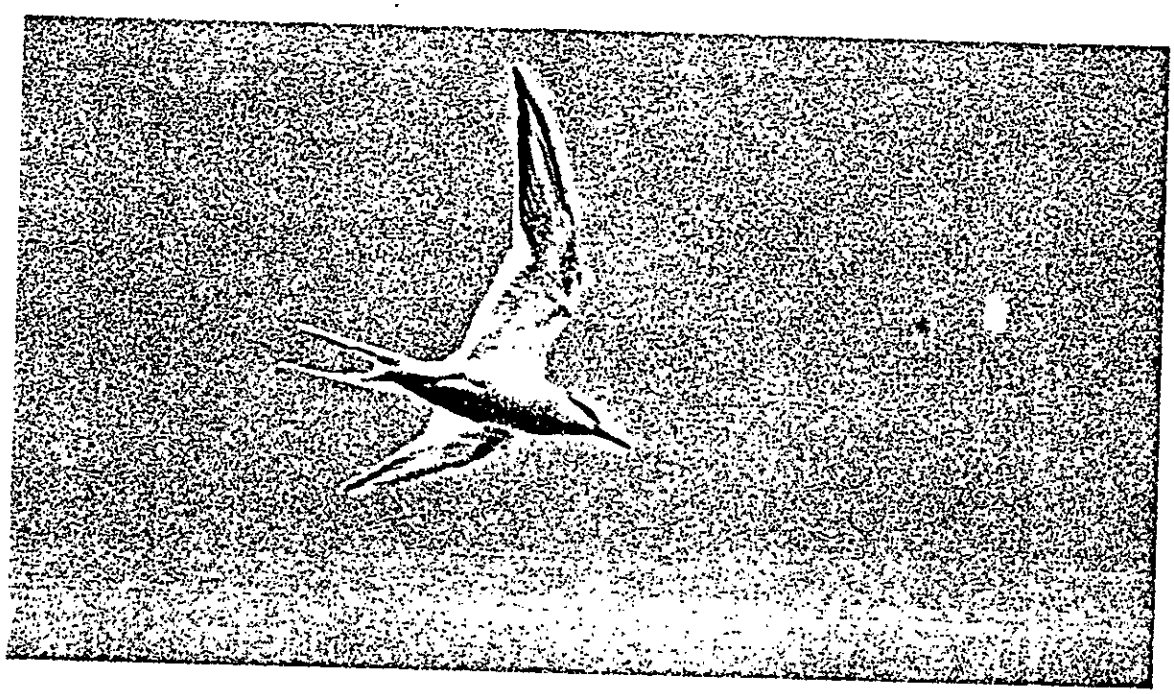

FIGURE 2.10. A Forster's tern. Note forked tail characteristic of this species.

9 2 1 2 3 7 7 1 9 1 3 2

FIGURE 2.11. Great Blue Herons in a rookery at White Bluffs on the Department of Energy Hanford Site.

FIGURE 2.12. Great Blue Heron colony at White Bluffs on the Department of Energy Hanford Site.

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FIGURE 2.13. The ring-necked pheasant is a common upland gamebird along the Hanford Reach.

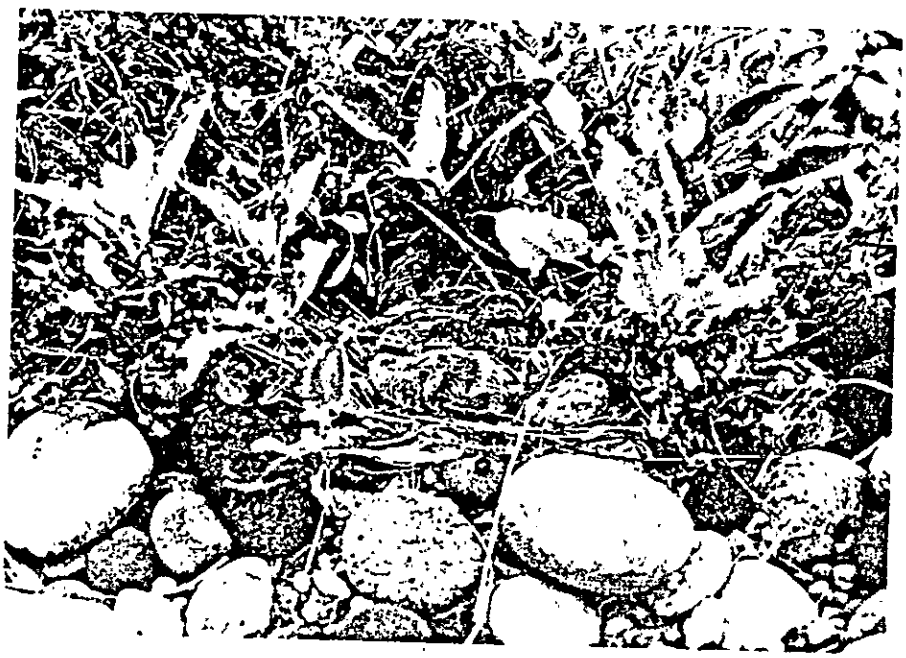

FIGURE 2.14. Mourning dove nest located in Eriogonum compositum habitat on Island 18.

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FIGURE 2.15. Eggs and nest of mourning dove in Lupinus sp. habitat.

FIGURE 2.16. A spotted sandpiper nest on Island 18.

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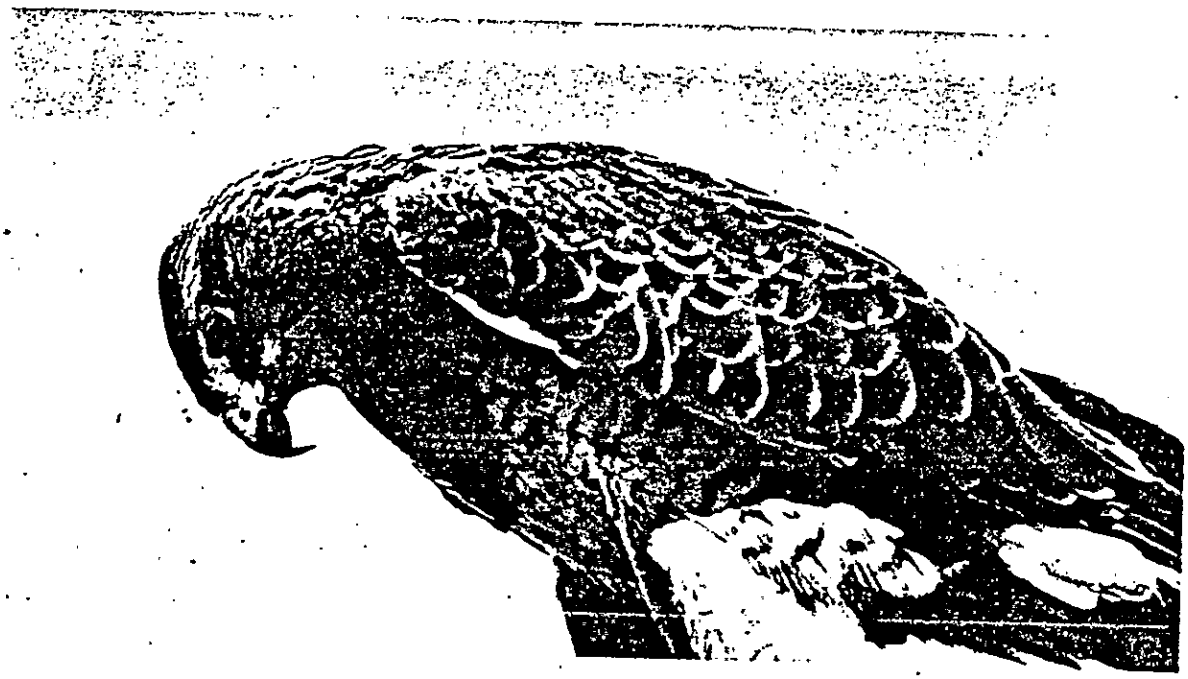

FIGURE 2.17. The Swainson's hawk nests on the Hanford Site.

FIGURE 2.18. A young long-eared owl. This species commonly nests in trees along the shoreline of the Columbia River.

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FIGURE 2.19. A group of mule deer feeding in a cheatgrass field below the 400 ft (122 m) contour.

FIGURE 2.20. The porcupine is a common resident along the Hanford Reach.

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3.0 THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

3.1 INTRODUCTION

The purpose of this portion of the study is to identify and locate any Federally listed Threatened and Endangered Species or other species of concern along the Hanford Reach. For each species listed, the impact resulting from the Ben Franklin Dam alternative is discussed and means of mitigating adverse impacts explored. Enhancement opportunities are also discussed where applicable (see Table 3.1 for a listing of Threatened and Endangered Species and other species of concern).

A species may be Federally designated to be a Threatened or Endangered Species if any of the following apply:

- present or threatened destruction, modification or curtailment of its habitat or range
- over utilization for commercial sporting, scientific or educational purposes
- disease or predation
- inadequacy of existing regulatory mechanisms
- very small existing range, despite locally abundant numbers.

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3.2 PLANT SPECIES

There are no plant species in the Hanford Reach that are Federally listed as Threatened or Endangered. Several species are listed on the State of Washington working list of threatened and endangered species (Washington Natural Heritage Data System 1980). Three have been identified as candidates for Federal listing by the U.S. Fish and Wildlife Service.

Since the entire study area includes over 100 square miles (250 km^2) and is much too large to survey intensively by foot, we concentrated on those areas near and below the 400 foot (122 m) contour, and in areas where suitable habitat existed for the species of concern. The search areas and dates are shown in Table 3.2. Unfortunately, the time constraints of the study did not allow visits to all important areas before the vegetation dried. Therefore, dry

TABLE 3.1. Listed Threatened and Endangered Species and Other Species of Concern

Federally Listed Threatened and Endangered Species[a]

- Bald eagle, *Haliaeetus leucocephalus alascanus*
- Peregrine falcon, *Falco peregrinus americanus*

Species of Concern

Plants[b]

- Robinson's onion, *Allium robinsonii*[c]
- Riverbank wormwood, *Artemisia lindleyana*
- Columbia River milkvetch, *Astragalus columbianus*[c]
- Medick milkvetch, *Astragalus speirocarpus*
- Rosy balsamroot, Balsamorhiza rosea
- Cryptantha, *Cryptantha leucophaea*
- Cusick's sunflower, *Helanianthus cusickii*
- Rorippa, *Rorippa calycina* var. *columbiae*
- Liverwort monkey flower, *Mimulus jungermannioides*[c]
- Phacelia, *Phacelia lenta*

Wildlife

- Swainson's hawk, *Buteo swainsoni*
- Ferruginous hawk, *Buteo regalis*
- Golden eagle, *Aquila chrysaetos*
- Sandhill crane, *Grus canadensis*
- Sage thrasher, *Oreoscoptes montanus*
- White pelican, *Pelecanus erythrorhynchos*
- Double crested cormorant, *Phalarocorax auritus*
- Great blue heron, *Ardea herodias*
- Black-crowned night heron, *Nycticorax nycticorax*
- Whistling swan, *Olor columbianus*
- Goshawk, *Accipter gentilis*
- Osprey, *Pandion haliaetus*
- Merlin (pigeon hawk), *Falco columbarius*
- Gyrfalcon, *Falco rusticolus*
- Prairie falcon, *Falco mexicanus*
- Sage grouse, *Centrocercus urophasianus*
- Forster's tern, *Serna forsteri*
- Arctic tern, *Sterna paradisaea*
- Caspian tern, *Sterna caspia*
- Burrowing owl, *Athene cunicularia*
- Western bluebird, *Sialia mexicana*
- Sage Sparrow, *Amphispiza belli*
- Pygmy rabbit, *Sylvilagus idahoensis*
- Merriam's shrew, *Sorex merriami*
- Silver-haired bat, *Lasionycteris noctivagans*
- Hoary bat, *Lasiurus borealis*
- Pallid bat, *Antrozous pallidus*
- White-tailed jackrabbit, *Lepus townsendii*
- Northern pocket gopher, *Thomomys talpoides limosus*
- Ord's kangaroo rat, *Dipodomys ordii*
- Northern grasshopper mouse, *Onychomys leucogaster*
- Sagebrush vole, *Lagurus curtatus*
- Short-tailed weasel, *Mustela erminea*
- Woodhouse's toad, *Bufo woodhousei*
- Desert horned lizard, *Phrynosoma platyrhinos*
- Striped whipsnake, *Masticophis taeniatus*
- Pacific gopher snake, *Pituophis melanoleucus catenifer*
- Desert night snake, *Hypsiglena torquata*
- Columbia River tiger beetle, *Cicindela columbica*[c]
- Oregon swallowtail, *Papilio oregonius*

Aquatic Organisms[d]

- Chinook salmon, *Oncorhynchus tshawytscha*[c]
- Coho salmon, *Oncorhynchus kisutch*[c]
- Sockeye salmon, *Oncorhynchus nerka*[c]
- Steelhead trout, *Salmo gairdneri*[c]
- Giant Columbia River limpet, *Fisherola nuttalli nuttalli*[c]
- Great Columbia River spire snail, *Lithoglyphus columbiana*[c]

[a] Federal Threatened and Endangered Species List, 50 CFR 17, Federal Register, 20 May 1980

[b] Washington State Working List of Threatened and Endangered Plants (Washington Natural Heritage Data System, 1980)

[c] Proposed as Candidates for Federal Listing by U.S. Fish and Wildlife Service

[d] Washington State Department of Game, Wildlife Management Division, Non-Game Program Species of Special Concern (Washington Natural Heritage Data System, 1980)

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TABLE 3.2. Search Schedule and Findings

Date	Area	Special Plants
May 1, 1980	Benton Co. side, between Priest Rapids Dam and Vernita Bridge	Astragalus columbianus Allium robinsonii
May 7	Benton Co. side, Vernita Bridge to 100-D	
May 9	Grant Co. side, Priest Rapids to Vernita Bridge	Allium robinsonii
May 12	Benton Co. side, WPPSS water intake to 5 miles north	Cryptantha leucophaea
May 13	Benton Co. side, between White Bluffs and 100 F, Island 8	
May 15	Benton Co. side, WPPSS water intake to 300 Area	
May 16	Benton Co. side, 100 F Slough to Hanford Slough	Allium robinsonii
May 20	Benton Co. side, Hanford Slough to 3 miles into sand dunes	Rorippa calycina var. columbiae
May 21	Grant Co. side, Vernita Bridge to ca. 4 miles downstream	
May 23	Grant Co. side, White Bluffs to Jap Slough	
May 28	Islands 3, 4 and 5	
May 30	Island 6	
June 3	Grant Co. side, Coyote Rapids to White Bluffs. Benton Co. side, Coyote Rapids to White Bluffs	
June 4	Hanford Slough	Allium robinsonii
June 5	Franklin Co. side, across from Island 7 to Hanford Slough	
June 6	Islands 11 and 12	
June 9	Island 13	
June 10	Islands 14 and 15	
June 11	Franklin Co. side, Ringold Flats to across from Island 19. Benton Co. side, Richland to 300 Area	
June 16	Islands 17 and 18	
June 17	Island 19	

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fragments were used and are discussed where appropriate. Shore areas were surveyed by car and on foot. Island areas were visited by boat and searched on foot. Areas near and below the 400 foot contour were carefully searched on foot; these habitats would receive the most impact from the Ben Franklin Dam alternative and are also the most probable locations for the species on the list. Habitats above the 400 foot contour are disturbed by past or present agricultural use and for this reason were searched less intensively. A total of 53 man-days was spent searching for plants. Nevertheless, it should be noted that while location of a taxon proves its presence on the Hanford Reach, its absence is not proven by our inability to locate it.

Each of the plant species listed in Table 3.1 is discussed individually with respect to current legal status, morphological and ecological characteristics, the findings of this study and the impact and any potential enhancement related to the Ben Franklin Dam alternative.

A temporary but interesting problem in locating plant species was the ash fall from the May 18, 1980 Mt. Saint Helens eruption which covered low plants and changed the appearance of all vegetation (Figure 3.1).

Allium robinsonii is an onion found in "sand and gravel deposits along the Columbia River from near Vantage, Washington, to about the mouth of the John Day River, Oregon, apparently restricted to the bottom and lower benches of the river valley" (Hitchcock et al. 1969, Vol. 1, p. 755). Its bulb has a grayish outer layer. The two leaves are flat and curved and the flowers are pinkish and only slightly elevated above the soil surface (Hitchcock et al. 1969, ibid.). This species is endemic to Washington and Oregon (Washington Natural Data System) and has been identified by the U.S. Fish and Wildlife Service as a candidate for Federal listing.

Survey of the Hanford Reach showed that this onion occurred approximately one mile upstream from the Vernita Bridge, Benton County side of the river; two miles south of 100 F Slough; on Islands 3, 13, 15, and at Hanford Slough (see Figure 1.2 for place names). The previous collection sites provided by Washington Natural Data System (1980) (Coyote Rapids, Islands 19 and 20 and mainlands opposite them) could not be confirmed, possibly because the plants

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became dormant about the same time this study started. The collection site at Hanford Slough was confirmed.

The species was consistently found near or within a line of drift wood from previous floods, approximately 20-30 feet (7-10 m) above this year's high water level (Figure 3.2). It was always found on silty and usually stoneless soil, except on Island 15 where silt has almost covered the cobbles. The late survey time precluded collection of living material, but fragments collected were adequate for identification. Unfortunately, we were unable to obtain an accurate estimate of density by fragments. This species has a very narrow habitat range and could be easily extirpated by disturbances in the old drift wood zone.

Allium robinsonii appears similar to Allium tolmiei (Figure 3.3). Confusion between the two species can be resolved by timely field surveys and access to a good collection of reference materials. Since A. tolmiei is not a species of concern at this time due to its widespread occurrence, distinction between the two onions is important.

The impact of the Ben Franklin Dam alternative would be to eliminate the observed populations of this species as the habitat would either be flooded or invaded with willows and other shoreline species. Since it is only found in sparsely vegetated areas, any increase in other species would likely eliminate Allium. Allium has never been found among willows. No enhancement effects of the Ben Franklin Dam alternative were identified for this species.

Astragalus columbianus (Figure 3.4) is a milk vetch in the pea family. This perennial is a low plant that dies back to the soil surface each year when summer drought prevents further growth. A recent investigation (Sauer et al. 1979) has shown this rare endemic species, once thought to be extinct, to be present in the vicinity of Priest Rapids Dam. It is found on open sandy to silty soil where competition with cheatgrass (Bromus tectorum) is minimal. It was collected once in 1883, again in 1922 and in 1977 and 1978 (Sauer et al. 1979). This species has been identified by the Fish and Wildlife Service as a candidate for Federal listing. This species is identified as endemic to the State of Washington in 1979 data of the Washington Natural Heritage Program.

The findings of this survey confirmed the earlier findings of the distribution of A. columbianus and extended its known range approximately 1 mile (1.6 km) east. The narrow band of occurrence, almost on the 420 foot (126 m) contour, is frequently disturbed by cattle and sheep grazing. Whether the occurrence of A. columbianus in grazed areas is coincidental or functional is not known and will require further research.

The direct impact of construction and operation of the Ben Franklin Dam alternative on A. columbianus is unlikely to be significant because it is presently located above the 400 foot (122 m) contour near Priest Rapids Dam. However, the Ben Franklin Dam alterntive could indirectly affect this species. A rise in water level could encourage weedy shore vegetation such as willow which would eliminate A. columbianus from the area. Recreational use of the reservoir would also extirpate the species from the affected area and thus reduce its known range by as much as 1/2 to approximately 1/4 square miles (1.3 to 0.6 km^2). No enhancement effects of the Ben Franklin Dam alternative for this species were identified.

Mimulus jungermannioides is a perennial monkey flower that grows on "moss mats on cliffs at the eastern end of the Columbia River gorge in Washington and Oregon and extends along the Deschutes River to Maupin" (Hitchcock et al. 1969, Vol. 4, p. 345). Though rarely collected, M. jungermannioides has no official state or Federal status at this time. It has been identified by the U.S. Fish and Wildlife Service as a candidate for potential Federal listing and is considered endemic to Washington and Oregon by the Washington Natural Heritage Program.

Moss mats are rare, if they exist, along the Hanford Reach. The only known possibilities are the seeps and waterfalls along the bluffs on the Franklin County side of the Columbia River. These were searched, but no specimens of Mimulus jungermannioides were found. There are two reasons for the absence of the species from the Hanford Reach. Since these sources of moisture are relatively recent, it is doubtful that the species has had time to become established. Moreover, the substrate at many of the moist areas is too crumbly and unstable to support establishment of a perennial species.

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Artemisia lindleyana, wormwood, is a perennial that dies back to the soil surface each winter. It grows on sandy or rocky shores along the Columbia River and other fresh waters in the Northwest (Hitchcock et al. 1969, Vol. 5, p. 63). This rare species is on the Washington State working list of threatened and endangered species.

This survey indicates most of the shore and island margins of the Hanford Reach are suitable habitat for this species. The technical description indicates some variability in the morphology of this species. During the survey, considerable difficulty was encountered in separating A. lindleyana from A. ludoviciana, a more widespread species (Figures 2.5, 2.6, 2.7). A satisfactory separation of these two species was not made in this study. The taxonomy of the group of species to which these two belong is considered to be very difficult and in need of considerable study and revision (Hitchcock et al. 1969, Vol. 5, p. 54). Specimens were collected at many sites and have been filed in the U.S. Department of Energy's Arid Lands Ecology Reserve herbarium.

The impact of the Ben Franklin Dam alternative on this species would be temporary, as these plants appear readily able to colonize new habitats along fresh water. The Ben Franklin Dam alternative, through adding shoreline, could enhance the numbers of this species and its range. Since this species now appears to be abundant, however, such enhancement remains insignificant.

Astragalus speirocarpus, a perennial species of milk vetch, similar in growth requirements to A. columbianus, occurs in the "sagebrush desert, especially near the Columbia River, probably restricted to Yakima, Kittitas, Klickitat and Benton Counties, Washington" (Hitchcock et al. 1969, Vol. 3, P. 264). This species has no listed Federal status and is identified as endemic Washington State (Washington Natural Data System 1980).

A. speirocarpus is present west of Priest Rapids Dam where it is sympatric with Astragalus columbianus. No A. speirocarpus was seen along the Hanford Reach during this study, and previous collections in 1935 of this species reported along the Hanford Reach by the Washington Natural Heritage Data System (1980) were not confirmed. While A. columbianus and A. speirocarpus may have existed along the Hanford Reach before the practice of agriculture in the region, it

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is probably not present now because of extensive disturbance along the river (Figure 2.8). Hence, the Ben Franklin Dam alternative could neither harm nor enhance the range of these species. If Astragalus speirocarpus is present, the rise in water level and growth of shoreline vegetation could extirpate it from the area near the reservoir.

Balsamorhiza rosea, rosy balsam root, is a perennial composite species confined to exposed basaltic outcrops on hill tops (Rickard et al. 1978). The status of this species is described as endemic by Washington State. Since the potentially impacted area is at least 1000 feet (300 m) elevation below the nearest potential habitat for this species, the Ben Franklin Dam alternative would have neither a negative or positive direct or indirect effect on this species.

Cryptantha leucophaea (Figure 2.9) is a perennial herb that dies to the ground in summer when drought prevents further growth. It is found in "dry, often sandy places near the Columbia and lower Yakima Rivers from Wenatchee, Washington, to The Dalles, Oregon, reputedly also in southern British Columbia" (Hitchcock et al. 1969, Vol. 4, p. 194). This species is on the state working list, of rare, threatened, and endangered plants (Washington Natural Heritage Data System 1980).

We observed C. leucophaea growing in the sand dune area, Benton County, just north of the WNP 1,2, and 4 sites (Figure 1.2). These findings confirm the one location given by Washington Natural Heritage Data System (1980). The habitat at this location is sandy but not on the face of an actively moving dune. The soil is partially stabilized by Bromus tectorum and other common plants.

The impact of the Ben Franklin Dam alternative on this species would probably be minimal unless there are changes in the sand dune habitat (Figure 3.10). Most of the dunes and sandy surrounding area appear to be above the 400 foot (122 m) contour, but the presence of increased supplies of ground water may allow such woody species as willow to take over this habitat. Since Cryptantha does not grow in willows, its habitat would be altered. No enhancement potential of the Ben Franklin Dam alternative on this species is evident.

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Helianthus cusickii is a perennial sunflower that dies to ground level during winter. It is found on "dry open plains and foothills from California to Ellensburg, Washington" (Hitchcock et al. 1969, Vol. 5, p. 229). A collection site listed by the Washington Natural Heritage Data System (1980) was not confirmed. No published state or Federal status has been given.

This species occurs in the area surrounding the Hanford Reach. H. cusickii was collected during this study near Ringold and along the bluffs opposite Island 14.

The habitat requirements for this sunflower are relatively broad; hence, the Ben Franklin Dam alternative could be expected to have little, if any, deleterious effect on this species along the Hanford Reach. Because this species grows in dry areas above the 400 foot (122 m) contour, the presence of the dam and its pool would not enhance the plant's survival.

Rorippa calycina var. columbiae, a rare perennial species of cress, grows in moist sandy habitats (Hitchcock et al. 1969, Vol. 2, p. 535). It is listed on the Washington State Working lists it as rare, endangered, and threatened plants (Washington Natural Heritage Data System 1980). The site of a previous collection, Hanford Slough, was confirmed. The habitat of this species is flooded during the spring runoff and in inundated and dewatered daily during the rest of the year.

The pool created by the Ben Franklin Dam alternative would adversely affect the range and vigor of this species by inundating its habitat. Water levels undergo daily fluctuations that erode the soil or cover and expose this species.

Very little is known about Phacelia lenta. Only one collection is known from 1883 along the "bare hills of the Columbia River, Washington" (Piper 1901). The single specimen appears to have been collected at the same time Astragalus columbianus was collected, suggesting the two were found in the same vicinity, near Priest Rapids. The species is described as potentially extinct by the Fish and Wildlife Service and as endemic in Washington State (Washington Natural Heritage Data System, 1980).

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Phacelia lenta may be present along the Hanford Reach; however, a more extensive search earlier in the spring would be required to locate it. The effect of the Ben Franklin Dam alternative cannot be said to be detrimental or beneficial to this species until more is known about its range and ecology.

3.3 WILDLIFE

Two federally listed Threatened or Endangered animal species are known to occur within the Hanford Reach (Table 2.1), the bald eagle and peregrine falcon. The Washington Department of Game in cooperation with the Nature Conservancy is compiling a draft listing of "threatened" and "species of concern" presented in the Washington Natural Heritage Data System (1980). Two wildlife species are Federally listed as Threatened or Endangered that occur on the Hanford Site, and 40 additional Hanford terrestrial wildlife species are listed as state-designated "species of concern" category. Table 3.1 presents all wildlife species on the Washington State Game Department working list (Washington Natural Heritage Data System 1980) which occur on the Hanford Site.

2.3.1 Threatened Species (Federal Designation)

Bald Eagles

Since 1961, a study of bald eagles has been conducted on the section of the Columbia River which flows about 50 miles (80 km) through the U.S. Department of Energy's National Environmental Research Park in southcentral Washington. Aerial census flights for waterfowl were initiated as part of a U.S. Atomic Energy Commission (now Department of Energy) research program designed to investigate waterfowl use of the Hanford Reach of the Columbia River. Bald eagles were counted along with waterfowl. Census flights were made twice each month during November and December of one calendar year and January and February of the next, including the winters of 1961-62 through 1969-70, and from 1974-75 through 1979-80. Two observers counted birds and salmon redds from an aircraft flying at a speed from 85-100 mph at an elevation of 50-70 m. Surveys generally were conducted from 0700 to 1000 hr. Three communal night roosts (Figure 3.11) were observed periodically from 1974 through 1977. Eagles were

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classified as adults (pure white heads) or subadults. Diet data were obtained by examining prey remains found on the ground at the night roost in 1975 and 1976 (Table 3.3).

Bald eagles generally arrive on the Hanford Reach during mid-November and are present from late November through early February (Fitzner and Hanson 1979). Most are gone by early March. Waterfowl use of the Hanford Reach also follows a similar temporal distribution pattern and suggests that the eagles are accompanying southward movements of waterfowl upon which they feed. Spencer (1976) indicates that this occurs and also that bald eagles might act independently of waterfowl migrations and head directly to a regularly occurring supply of fish. In areas such as the Hanford Site where both waterfowl and fish are available as prey, we suspect bald eagles may be operating in both ways.

The bald eagles display a distribution pattern similar to that of waterfowl, but if salmon are available along with ducks, fish may influence the numbers of bald eagles present. Since waterfowl use of the Columbia River has decreased during the 1970's, one would expect that additional bald eagle use of this established prey resource would occur if some other prey became more available. We have compared maximum yearly eagle numbers (Figure 3.12) with salmon redd counts (Figure 3.13) and waterfowl counts (Figure 3.14) to determine if indeed eagle density is a function of salmon density or waterfowl density or both. A significant negative correlation ($p < 0.05$) suggests that eagles were not dependent on waterfowl. Even though wintering duck populations decreased from over 100,000 in the 1960's to about 70,000 in the 1970's, the number of crippled ducks available to eagles may have doubled due to increased hunting pressure. Thus, our waterfowl survey data would not reveal the true importance of ducks as prey for bald eagles. A nearly significant positive correlation ($p < 0.10$) was found between number of bald eagles and salmon redd densities, however, and suggests a food base relationship is operating here.

These findings suggest a relationship between salmon and bald eagles; however, single factor relationships are not generally the rule in nature and no doubt a number of other parameters are operating to direct bald eagles to

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TABLE 3.3. Foods of Bald Eagles on the Hanford Site (Fitzner and Hanson 1979)

Prey Species	Recorded Items	Approximate Biomass* (grams)	Percent Biomass
WATERFOWL			
Mallard (Anas platyrhynchos)	23	24,219	32
American Wigeon (A. americana)	8	7,032	9
Pintail (A. acuta)	1	997	1
Green-winged Teal (A. crecca)	2	680	1
American Coot (Fulica americana)	10	6,500	9
Gadwell (S. strepera)	1	989	1
FISH			
Chinook salmon (Oncorhynchus tschawytscha)	21	31,500	41
Sucker (Catastomus sp.)	4	2,800	4
European carp (Cyprinus carpio)	1	1,200	2
Chiselmouth (Acrocheilus alutaceus)	1	400	1

* Average weights of prey items were determined from data collected by R. E. Fitzner, D. G. Watson and D. A. Neitzel at Battelle, Pacific Northwest Laboratories.

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the Hanford Reach. Hunting pressure on waterfowl for instance, has increased substantially along the Hanford Reach of the Columbia River over the study period and the number of crippled waterfowl must also have increased. Increased use of the Hanford Site may also be the result of a shift in distribution related to depletion of bald eagle wintering habitat in other areas of the Northwest.

Additionally, during the 1960's, a considerable amount of nuclear reactor construction activity took place on the Hanford Reach of the Columbia River, but by 1970 this activity had ended. Today the Hanford Site serves as a sanctuary for bald eagles and their prey where they can live relatively undisturbed

by man. The relatively long-term data base presented here may in the future serve as a useful environmental barometer for detecting impacts of man-related activities along the Columbia River and may also help clarify some of the uncertainties associated with predator-prey interactions.

The Ben Franklin Dam alternative would conflict with bald eagle use of the Hanford Reach primarily through the elimination of salmon, a major prey source (Fickeisen et al. 1980). Roost sites and loafing areas would also be greatly reduced from flooding due to impoundment of the Hanford Reach. Elevated perches for roosts and loafing areas are believed to be a major factor needed by bald eagles in their wintering areas. Measures to reduce adverse impacts could include supplemental feeding and creation of artificial perch structures and preservation of existing communal night roosts. The roost sites should also be protected against encroachment by man's activities (Snow 1973).

Peregrine Falcon

An aerial survey for peregrine and prairie falcon nest detection was flown on April 25, 1980. The survey route encompassed all available cliff nesting habitat from Hanford townsite upstream to Wanapum Dam.

No peregrine falcons were observed nesting in this stretch of river, but five pair of prairie falcons were confirmed. Only one pair of prairie falcons nested within the Hanford Reach and these were found near Locke Island (No. 6) on the White Bluffs. Christmas bird counts by the lower Columbia Basin Audubon Society provide a few peregrine falcon records (American Birds 1978) for the Tri-Cities area. An accurate assessment of raptor nesting on the steep, narrow cliffs above Vernita Bridge is extremely difficult to obtain due to the steep terrain. Our preliminary findings should therefore not be considered as presenting an absolute count of raptors present. Additional prairie falcons and even peregrine falcons could be present on the cliffs above Vernita. A full-scale field effort is needed to describe the nesting density of birds of prey along the Columbia River above Vernita accurately.

To date, no peregrine falcons have been observed nesting within the Hanford Reach. Winter or migratory sightings of transient birds can be expected along the Hanford Reach in the future.

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Statements relative to the impacts of the Ben Franklin Dam alternative on peregrine falcons would be totally speculative at this time without further surveys of raptor use. The impoundment could be favorable for the birds if the prey resources (shorebirds, waterfowl, songbirds) increased. Undisturbed cliff nesting sites would need to be present to induce nesting. Use of the Hanford Site for feeding during migration could increase over present conditions.

3.3.2 Other Species of Concern

Swainson's hawks are a common nesting species on the Hanford Site. About 20 nesting pairs occur on the site each year and at least four of these pairs nest (Figure 3.15) below the 400 foot (122 m) contour.

Ferruginous hawks are uncommon on the Hanford Site and one pair is known to nest on the Arid Lands Ecology Reserve above 2000 feet (610 m) elevation (Figure 1.3). Several fall sightings have occurred near the sand dune area.

The golden eagle is a common winter visitor on the Hanford Site and an uncommon summer visitor. During the winter, golden eagles are often observed hunting along the Columbia River below the 400 foot (122 m) contour. Probably eight to ten birds winter on the Hanford Site.

Sandhill cranes are observed frequently during the spring and fall as they migrate over the Hanford site. Six birds were observed at a pond near the 200 W area on October 5, 1973, but no other sightings of birds on the ground have been made (Fitzner and Rickard 1975). Most of the cranes passing over the Hanford Site are believed to be the little brown sandhill crane (Grus canadensis canadensis) and not the larger race (G. c. tabida). The only known nesting by the rare greater sandhill occurs on the Conboy National Wildlife Refuge near Goldendale, Washington, and perhaps on the Yakima Indian Reservation.

The sage thrasher is rather uncommon on the Hanford Site (Rotenberry 1978). Migrating birds are seen but nesting has not been recorded.

In 1979, a small colony of pygmy rabbits was found on the side slopes of Rattlesnake mountain, above 1200 foot (366 m) elevation. No records are available for lower elevations.

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The habitat of the Columbia River tiger beetle (Cicindela columbica Hatch) has been previously described by Leffler (1976) as open sand dunes and bars immediately adjacent to the Snake River upstream as far as Lewiston and lower Columbia River as far downstream as The Dalles (Figure 3.16). No specimens have been collected on the Columbia River since the construction of hydroelectric dams. Beer (1971) collected tiger beetles all along the Columbia River in Oregon on seven separate occassions and found no specimens of C. columbica. He had reported collecting this species on the Snake River below Lewiston, Idaho in 1970. This area has since been inundated by Lower Granite Dam. Researchers at Battelle, Pacific Northwest Laboratories have done limited collecting for this species on the Hanford Reach from 1973 to the present without success. Although specimens have not been collected on the Hanford Site, populations may exist on areas of sand shoreline not sampled. The species has been proposed for Federal listing as Threatened and Endangered by the U.S. Fish and Wildlife Service.

Because the Hanford Reach is the last remaining suitable habitat in Washington for C. columbica, a complete search is needed in both spring and fall (the reported times of emergence) to verify the existence of this species. The Ben Franklin Dam alternative would destroy habitat recognized as suitable for Columbia River tiger beetles in Washington. Although the sand dune shoreline across from Island 11 would be naturally re-created in the same form as is present today, island sand bars would become inundated.

The Oregon swallowtail (Papilio oregonius Edwards), a butterfly, inhabits the arid portions of the Columbia River where its larval host plant, tarragon (Artemisia dracunculus), is abundant. The Hanford Reach offers good habitat for this species with tarragon growing along the shoreline and islands from Priest Rapids Dam to Richland. P. oregonius was collected here in July, 1978 by Paul P. Feeny, associate professor from Cornell University, New York. No further collections on the Hanford Reach have been made.

P. oregonius has been identified as an animal species of concern by the Washington Natural Heritage Data System (1980). Pyle (1974) has reported large declines in the populations of many butterfly species including the Oregon

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swallowtail since the construction of hydroelectric dams on the Snake and Columbia Rivers. Similarly, the Ben Franklin Dam alternative could result in further losses to the existing populations of P. oregonius. The pool would inundate some stands of A. dracunculus, which are essential to the survival of P. oregonius, although tarragon can be found both above and below the 400 foot (122 m) contour of the river. An assessment of factors involved in the decline of P. oregonius in areas of historic abundance may reveal whether or not the Ben Franklin Dam alternative would cause the Oregon swallowtail population to suffer further decline.

Several records of Woodhouse's toad (Figure 3.17) are available for the Hanford Reach. Several adults were observed in the White Bluffs Slough area during the summer of 1979 and 1980 and other records are available for Island 6 and shoreline areas from the 100 D area downstream to Hanford townsite. As with many other amphibians, this toad requires water for breeding and for maintenance of body water.

Fitzner et al. (1979) indicate that the desert horned lizard occurs uncommonly on the Hanford Site in habitats dominated by antelope bitterbrush (Purshia tridentata, Figure 3.18) and big sagebrush (Artemisia tridentata). No records exist for this species below the 400 foot (122 m) contour on the Hanford Site.

Several striped whipsnakes are observed each year in areas of the Hanford Site which are dominated by antelope bitterbrush and sagebrush. No records exist below the 400 foot (122 m) contour.

The Pacific gopher snake (Figure 3.19) is a common species on the Hanford Site and occurs in a variety of habitats. Observations have been made on Islands 6, 12, 17, 19 and 20, and along the Columbia River shoreline. Dry areas tend to be used more frequently than riparian habitats.

The desert night snake (Figure 3.20) is limited in its distribution on the Hanford Site, occurring mostly in association with basalt outcroppings and dry habitats. Several records exist for the Gable Mountain and Gable Butte areas, but no records of this snake exist below the 400 foot (122 m) contour.

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Winter waterfowl surveys indicate that between eight and ten white pelicans winter on the Columbia River between Island 1 and the Hanford powerline. The abundant fish prey resource in this stretch of the river is no doubt the major factor attracting and holding these birds over the winter.

A colony of double crested cormorants nested on Locke Island (No. 6) during the mid-1950's (Hanson 1968), but no nesting records are available for the 1970's. An occasional spring, summer, or fall visitor can be seen on the river. A small colony of double crested cormorants does exist on the Potholes Reservoir north of the Hanford Site.

A colony of about 80 nesting pairs of great blue herons exists on the White Bluffs peninsula. Throughout the year, these herons can be seen foraging on the shallows of the Columbia River. The rapidly flowing water in the Hanford Reach does not freeze up in winter and the birds thus often congregate to feed in the area during severe weather. Without the swift current, foraging areas would be absent and the herons would probably move to other areas or perish.

No black-crowned night heron nesting occurs on the Hanford Site today, but in the 1950's, Hanson (1968) noted a small colony on Locke Island. A large colony of these birds (1500-2000 pairs) lives on the Potholes Reservoir north of the Hanford Site. Year-round observations of this species are present for the Hanford Reach, but generally only one or two individuals occur at a time, mostly during spring and fall.

The whistling swan occurs on the Hanford Reach during fall and spring migration. Flocks of over 50 birds have been observed, but smaller groups of six to twelve birds are often seen. Most observations have been in areas above Hanford townsite.

Goshawks are typically birds of wooded areas and thus most of our observations are associated with riparian areas. All of our sightings have occurred from October to March. We have no records below the Hanford Reach 400 foot (122 m) contour, but sightings from the Yakima River delta area (American Birds 1978) would seem to indicate a use of riparian areas upstream through the Hanford Reach.

Osprey are closely associated with waterways and all of our observations have occurred within 2 km of water (chiefly the Columbia River). Ospreys have been observed during most months but are most often seen from July to December. The shallow pools and riffles in the Hanford Reach provide suitable foraging areas for this fish eater.

The merlin or pigeon hawk is separated into two races, Falco columbarius suckleyi and F. c. richardsonii. F. c. suckleyi resembles a small peregrine while F. c. richardsonii resembles a small prairie falcon. Both races could occur along the Hanford Reach; however, all of our observations are over 5 miles (8 km) from the Columbia River and are mostly associated with sagebrush habitats. F. c. suckleyi is a frequent winter visitor around the Tri-Cities area and is often recorded on winter Audubon Christmas Bird Counts (American Birds 1978). Observations are mostly associated with parks, cemeteries, shelter belts and other wooded areas.

A single gyrfalcon was observed adjacent to the Hanford Site in the winter of 1978-79, but none have ever been observed on the Hanford Site.

The Hanford Site presently harbors four nesting pairs of prairie falcons. Two are associated with the Columbia River, one in Benton County above Vernita Bridge and one in Franklin County on the cliffs opposite Island 6. Prairie falcons are often found nesting on cliffs in Benton and Franklin counties and do not appear to have a dependence on the water. They usually feed on small birds and mammals characteristic of shrub-steppe habitats.

During the 1950's and 1960's, sage grouse were often observed along the Hanford Reach of the Columbia River. During the 1970's and in 1980, however, our observations have been confined to the Arid Lands Ecology Reserve.

Forster's tern nests on Islands 18, 19 and 20. A habit of nesting on cobblestone substrate (Figure 3.21) close to water line places this species in jeopardy. Fluctuations of water level from Priest Rapids Dam have destroyed many nests in the past. Human visitations by an unknowing amateur bird enthusiast in 1977 completely destroyed all nesting on Island 18. The following year, the terns nested successfully on that island again. This species is quite sensitive to human disturbance and water fluctuations; precautions should

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be taken to reduce or eliminate these perturbations during the nesting season. The Forster's tern is discussed in greater detail in Section 2 of this report.

The arctic tern is a rare visitor to the Hanford Reach. Fitzner has observed single birds during the summers of 1973 and 1976. The Columbia River system may be used as a migratory route and probably is used for feeding by the few visitors passing through.

Caspian terns (Figure 3.22) are frequently seen along the Hanford Reach during the spring, summer, and fall. No nesting takes place on any of the Hanford Islands, but a small colony exists on Cabin Island above Priest Rapids Dam. The Hanford Reach is probably important as a feeding area to these birds, particularly from July to September when birds are recently off their breeding grounds.

At least eight pairs of burrowing owls (Figure 3.23) nest below the 400 foot (122 m) contour along the Hanford Reach of the Columbia River. They occur on the Hanford Site from March through September; however, fall and winter records are common.

Western bluebirds are a rare spring migrant on the Hanford Site. One bird was sighted near the 200 W Area on March 16, 1973.

The sage sparrow is characteristic of the sagebrush and bitterbrush habitats of the Hanford Site. Nesting is common in the sand dune area and within the 400 foot (122 m) contour from Hanford townsite downstream to Richland. This is an abundant bird during the nesting season but only occurs in habitats with shrub overstory.

Our mammal trapping data over the past 20 years reveal that Merriam's shrew occurs chiefly above 1000 foot (350 m) elevation and is associated with pristine shrub-steppe habitat. All of our records are from Rattlesnake Mountain on the Arid Lands Ecology Reserve.

Numerous observations of silver-haired bats are made every fall on the Hanford Site. A close association of this species with riparian areas is indicated by studies on the Hanford Site (Fitzner, Battelle unpublished). Tree roost sites are probably used during daylight. The Hanford Reach of the

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Columbia River, particularly in wooded areas and around buildings from Vernita Bridge through Hanford townsite, is probably used by this species.

At least four records of hoary bats exist for the Hanford Site. This species has been reported only in riparian areas.

A nursery colony of more than 100 female pallid bats and their young was found at the 100 F Area in July of 1979. We expect many of the old buildings associated with the 100 Areas to harbor this species as well as small myotis bats.

Several records of white-tailed jack rabbits are available for the Arid Lands Ecology Reserve but none occur east of Highway 240.

We are uncertain as to the occurrence of the northern pocket gopher on the Hanford Site. The Columbia River system acts as a barrier to restrict the range of this species to the east bank. Little taxonomic research has been done on subspeciation of Thomomys talpoides group in the Columbia Basin and no major trapping effort for Thomomys has occurred on the Hanford Islands or along the east or west bank. This subspecies may be present within the proposed Ben Franklin Dam alternative area. It is possible that the dam would provide a migration route across the river and accelerate extensions in the range of these gophers.

The Columbia River acts as a barrier to limit the distribution of Ord's kangaroo rat to the east bank of the river. Observations of burrows identical to kangaroo rat burrows have been made on Islands 19 and 20 and we expect these species to inhabit Islands 3 and 6 as well. As with the northern pocket gopher, the dam might provide a migration route across the river.

The northern grasshopper mouse is not a common member of any small mammal community on the Hanford Site, but it seems to be present in most areas. We have trapped individuals in the sand dune area below the 400 foot (122 m) contour (unpublished data).

All of our trapping over the years reveals that the sagebrush vole occurs principally above 1000 foot (350 m) elevation in pristine shrub-steppe habitat. No records exist for the species near the Columbia River.

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Few records exist for short-tailed weasel on the Hanford Site. One was trapped in the 200 W Area near U-Pond and another was captured near Rattlesnake Springs on the Arid Lands Ecology Reserve (Gano, Battelle unpublished, see Figure 1.2). We would anticipate that short-tailed weasels occur along the Columbia River below the 400 foot (122 m) contour.

3.3.3 Impacts of the Ben Franklin Dam Alternative on Wildlife Species of Concern

The Ben Franklin Dam alternative will impact several of the wildlife species listed as species of concern. The species we expect would be impacted are the Swainson's hawk, golden eagle, Columbia River tiger beetle, Oregon swallowtail, Woodhouse's toad, Pacific gopher snake, white pelican, double crested cormorant, great blue heron, osprey, Forster's tern, Caspian tern, burrowing owl, silver-haired bat, hoary bat, northern pocket gopher, Ord's kangaroo rat, and short-tailed weasel. The elimination of habitat will have the greatest effect on these species. Several species would be displaced through the loss of nest sites (Swainson's hawk, great blue heron, and burrowing owl) or by loss of food resources (golden eagle, white pelican, double crested cormorant, osprey, Caspian tern).

Mitigation for the loss of habitat may benefit some of the species of concern; however, all suitable habitat in Washington for the Columbia River tiger beetle would be inundated and no mitigation actions would help. The mitigation measures which could be used for some of the species of concern are as follows.

The Swainson's Hawk and burrowing owl would loose nest sites, but other areas of the Hanford Site presently lacking nest sites (Wahluke Slope, Saddle Mountain National Wildlife Refuge) could be used for constructing artificial nest sites. Olendorff and Stoddart (1974) and Call (1979) present a number of artificial nest types which could be used for nesting by Swainson's hawks and burrowing owls. Golden eagles would loose some hunting areas through inundation. The acquisition of land and supplemental funding programs could be used to mitigate habitat loss. The fish eating birds (white pelican, cormorant, herons, osprey, and terns would loose a valuable food resource with inundation of the Hanford Reach. A fish population could be established in time which may

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serve as a new food source. By the time a new fishery is established however, the birds may have moved elsewhere, or perished. Hence, the creation of a new food source may be to late to do much good. If the birds survive, immediate mitigation measures would be needed. We doubt that any can be found which would replace the prey base now present. Island and tree nesting habitat would be needed for the Forster's tern and great blue heron respectively. Creation of islands with dredged material (Coastal Zone Resources Division 1978, Hunt 1979) may provide new nest sites for terns, but behavioral features of nest site selection would need closer study to determine which substrate types are preferred by the terns. After creation of islands, a careful study of utilization would also be in order. Planting of trees (cottonwoods) for nesting sites for herons could be used to mitigate for the distruction of the White Bluffs colony. The silver-haired bat and hoary bat would lose roosting habitat through inundation of trees along the Hanford Reach. In time, however, willows and cottonwoods could be expected to invade the shorelines of the reservoir and new habitat would be available for the bats. Since little is known of the ecology of the silver-haired or hoary bats in Washington, we suggest that further studies be conducted either on Hanford or elsewhere in eastern Washington in order to gain a better understanding of habitat requirements and ecology of these bats.

The northern pocket gopher and Ord's kangaroo rat may be impacted by loss of habitat. Since there is little evidence of their presence on the Hanford Site, a full scale field search for these species should be conducted before making any recommendations on mitigation measures. Particular attention should be paid to habitat types utilized. The short-tailed weasel would initially be impacted by loss of riparian habitat along the Hanford Reach. In time (5-15 years) new riparian habitat may develop. We presently know little about the niche of short-tailed weasels on the Hanford Site and advise additional research be conducted before recommending mitigation actions.

3.4 AQUATIC ORGANISMS

No Federally listed Threatened or Endangered aquatic organisms are known to occur within the Hanford Reach (Washington Natural Heritage Data System 1980).

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However, the Hanford Reach provides important habitat for several species of concern. Species dependent on free-flowing waters of the Columbia River have no other habitat available because dams have impounded virtually the entire river from Bonneville Dam to Canada, with the exception of the Hanford Reach. The giant Columbia River limpet (Fisherola nuttalli nuttalli) and the great Columbia River spire snail (Lithoglyphus columbiana) were once found throughout the Columbia and Snake Rivers, but their range is now apparently restricted to the Hanford Reach. In addition, all species of Pacific salmon (Oncorhynchus spp.) and the steelhead trout (Salmo gairdneri) are considered species of concern. Several races of salmon depend on the Hanford Reach and it includes the last remaining mainstem spawning areas for fall upriver bright Chinook salmon (O. tshawytscha). Existing mainstem impoundments flooded other spawning areas and stocks were displaced to the Hanford Reach. However, there are no alternative sites available for further displacement. The effects of the Ben Franklin Dam alternative on fish resources, including salmon and steelhead are described in a previous study (Fickeisen et al. 1980).

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3.4.1 Fisherola nuttalli nuttalli (Giant Columbia River Limpet)

Taxonomy of the Lancidae is somewhat confused and the giant Columbia River limpet has been placed in either Lanx or Fisherola. Morrison (1955) separates the genera based on shell and muscle scar characteristics. Like other members of its family, it has no pseudobranch or lung and probably respires across the integument of a furrow between the mantle and foot (Pilsbry 1925). Basch (1963) states that limpets are normally either lotic or lentic but that most are unable to live in both habitats. The lotic types require high dissolved oxygen and stable temperatures. They suffer respiratory problems when subjected to heavy siltation. With a large exposed area, they are intolerant to drying, but their primary food source (diatoms) is dependent on incident light for photosynthesis. Thus, they are generally found between the low water elevation and the bottom of the photic zone. Apparently they have a simple, annual life cycle as bimodal size distributions are common (Basch 1963). According to Morrison (1955), Fisherola spp. have only been found in the Columbia River system, while Lanx spp. is restricted to coastal streams to the south. Late tertiary fossils of F. nuttalli lancides found at Minidoka, Idaho

demonstrate the presence of Fisherola in the Columbia River system since that time. Morrison speculates that they are both old relict groups endemic to single river systems.

The giant Columbia River limpet [Fisherola nuttalli nuttalli (Haldeman)] has only been reported in flowing water. It was common in the lower Snake River before 1871 (Cooper 1871). Before 1936, it was also found in the Spokane River; the Snake River near Rupert, Idaho; the Deschutes River near Maupin, Oregon; and the Columbia River near The Dalles, Oregon (Henderson 1929, 1936). Pilsbry (1925) reported it common in the Columbia River drainage.

Coutant and Becker (1970) found these limpets generally through the Hanford Reach and specifically at RM 368 (Rkm 589) and they found no difference in sizes or growth rates for them taken above and below Hanford reactor discharges (Becker 1973). Between October 1974 and June 1978 they were collected at several stations near the Washington Public Power Supply System (WPPSS) Nuclear Projects 1, 2, and 4 (WNP 1, 2, and 4) at RM 352 (Rkm 563). They were found in gravel and Ringold substrates at estimated densities ranging from 0 to 341 per square meter. In addition, they colonized basket samplers placed at the same stations, indicating the presence of a healthy, reproducing population (Page and Neitzel 1976, 1977, 1978, 1979; Page, Neitzel and Hanf 1979). Clarke (undated) collected invertebrates at many sites in the Columbia and Snake Rivers in 1974 and 1975. He found Fisherola nuttalli only in the Hanford Reach. Over the past 30 or 40 years several requests were received at the University of Michigan and the Smithsonian National Meseum of Natural History for identification of specimens. All of the Fisherola nuttalli were collected in the Hanford Reach (Arthur H. Clarke, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560, personal communication). Clarke considers this limpet to be restricted to the Hanford Reach as a result of impoundment of other suitable habitat and has recommended it be given Federal status as an Endangered Species (Clarke 1976). It is currently identified by the U.S. Fish and Wildlife Service as a candidate for Federal listing.

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On the basis that Fisherola nuttalli nuttalli is apparently restricted to the Hanford Reach and requires free-flowing water, the Ben Franklin Dam alternative would eliminate nearly all of its present habitat. It is thought that impoundment of other reaches of the Columbia River system has been responsible for elimination of these limpets from most of their pre-dam range (Clarke 1976). The species would very likely become extinct as a direct result of habitat loss. This impact of the dam would be unavoidable and no action is foreseen that would mitigate the loss.

3.4.2 Lithoglyphus columbiana (Great Columbia River Spire Snail)

The great Columbia River spire snail is a member of the Hydrobiidae which have strictly aquatic respiration across an internal gill. They require high dissolved oxygen levels and feed in water less than about 10 feet (3 m) deep (Pennak 1978). Until recently, the genus was known as Fulminicola.

From 1926-1928 these snails were reported from the Little Spokane River north of Spokane (Henderson 1929). Before 1936, they were also found in the Spokane River; the Snake River near Weiser, Idaho; and the Columbia River near Wallula and near the mouth of the Snake River (Henderson 1936). In 1974 and 1975, collections were made at many sites in the Columbia River drainage but they were only found in the Hanford Reach (Clarke undated). In studies near WNP 1, 2, and 4, they were taken in 1979 (Beak Consultants, Inc. 1980) but not in 1974-1978 (Page and Neitzel 1976, 1977, 1978, 1979; Page, Neitzel and Hanf 1979). The great Columbia River spire snail is apparently less abundant than the limpet discussed above, and is considered to be restricted to the Hanford Reach as a result of impoundment and water quality degradation through its formerly more extensive range (Clarke 1976). On this basis, Clarke (1976) has recommended it be designated Threatened or Endangered. Currently this species is identified by the U.S. Fish and Wildlife Service as a candidate for Federal listing.

Impoundment of the Hanford Reach would eliminate the snail's only known present habitat, and no means to avoid or mitigate the loss of this species has been identified.

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FIGURE 3.1. Bird tracks in volcanic ash from Mt. St. Helens, Grant Co., near Vernita Bridge (May 22, 1980)

FIGURE 3.2. Typical Allium robinsonii habitat. Note open silty areas devoid of cheatgrass and driftwood (May 28, 1980)

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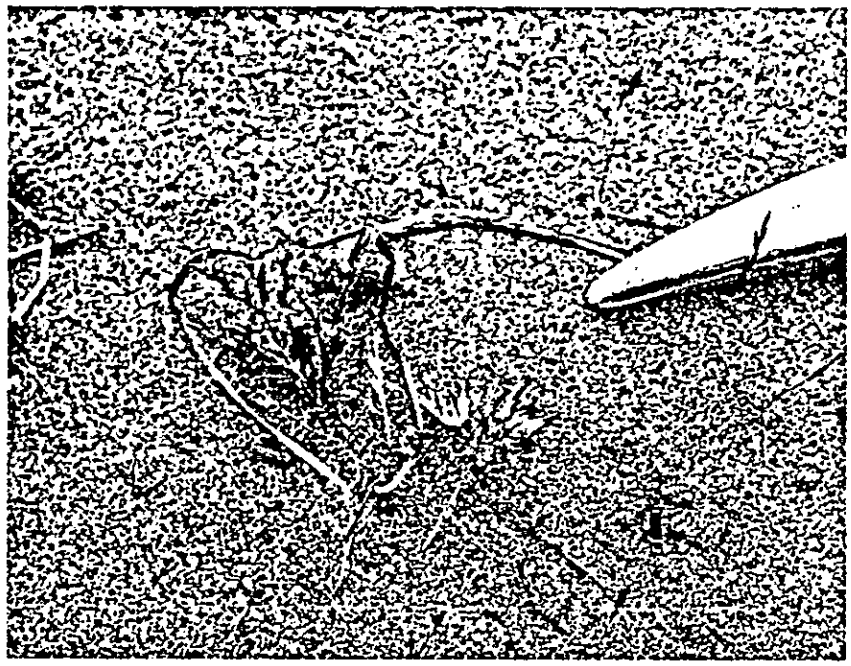

FIGURE 3.3. Fragments of Allium tolmei discovered May 9, 1980

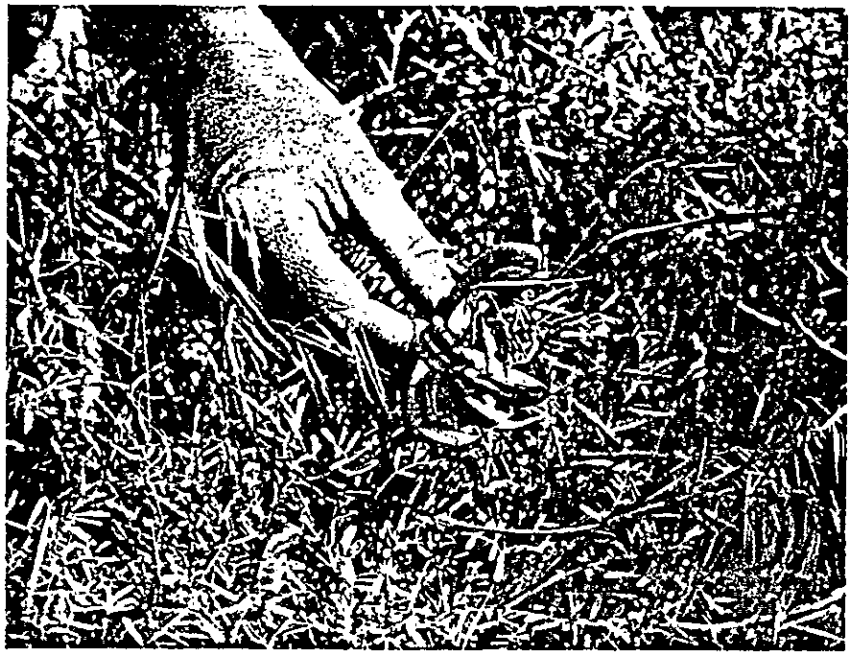

FIGURE 3.4. Fruit and foliage of Astragalus columbianus found at Vernita on China Bar, Benton Co. (May 1, 1980)

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FIGURE 3.5. Artemisia ludoviciana growing on Benton side, west of Vernita Bridge (May 1, 1980)

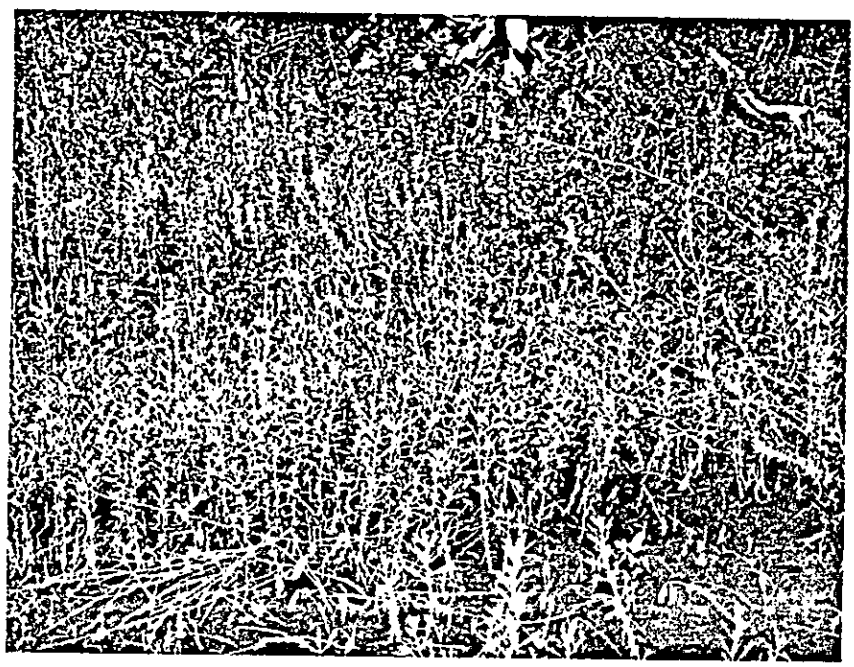

FIGURE 3.6. Artemisia lindleyana as it is commonly observed alo the Hanford Reach of the Columbia River. (Photo ta' May 21, 1980, at Vernita Bridge in Grant Co.)

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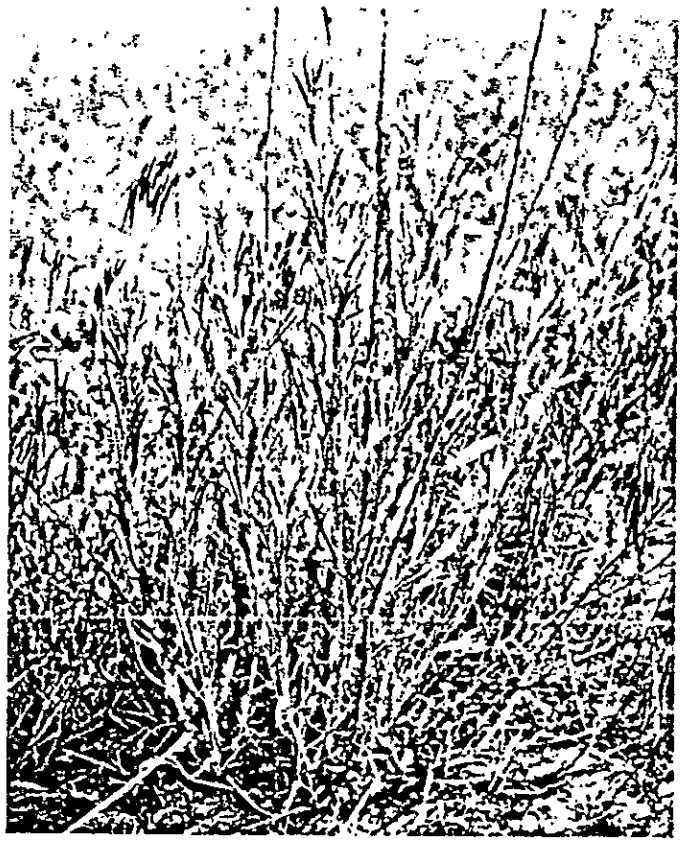

FIGURE 3.7. Artemisia lindleyana or A. ludoviciana at edge of cheatgrass near driftwood zone, approximately 30 m (100 ft) from water's (Photo taken May 1, 1980 in Benton Co. r Vernita Bridge.)

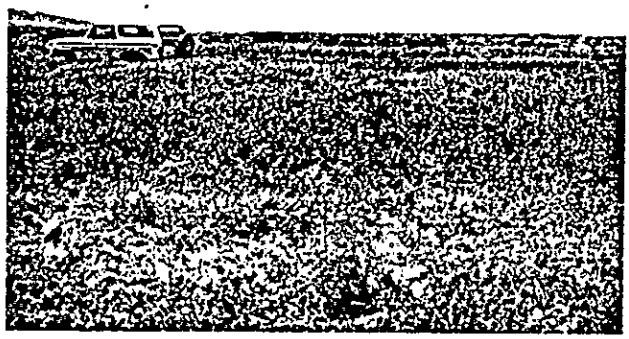

FIGURE 3.8. Typical abandoned agricultural land on Hanford Site near Hanford Slough (May 16, 1980)

9 2 1 2 3 7 7 2 0 1 6

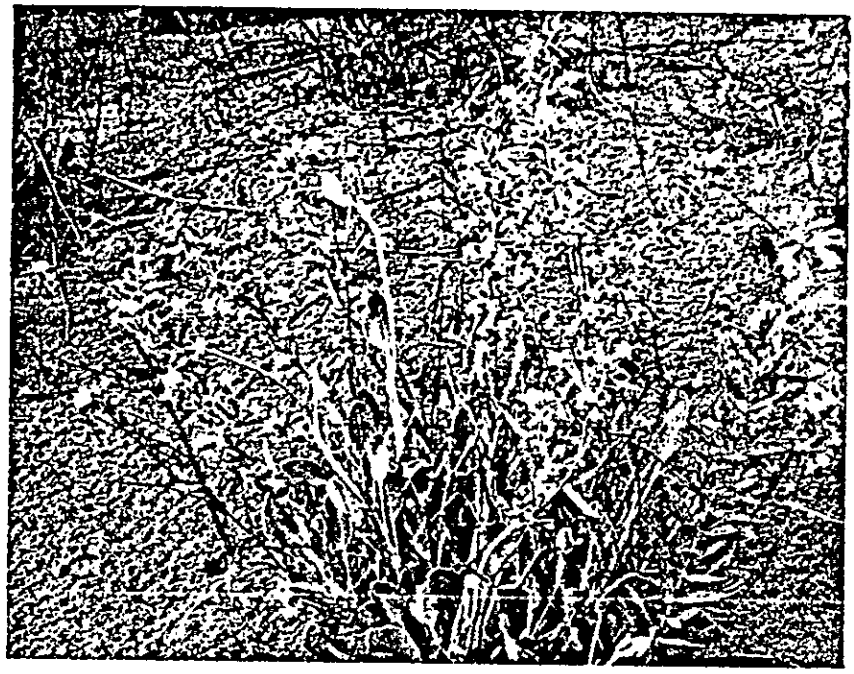

FIGURE 3.9. Cryptantha leucophaea on sand dune approximately four miles north of WPPSS lease area (May 12, 1980)

FIGURE 3.10. Partially stabilized sand dunes along Columbia River opposite Ringold Flats (May 12, 1980)

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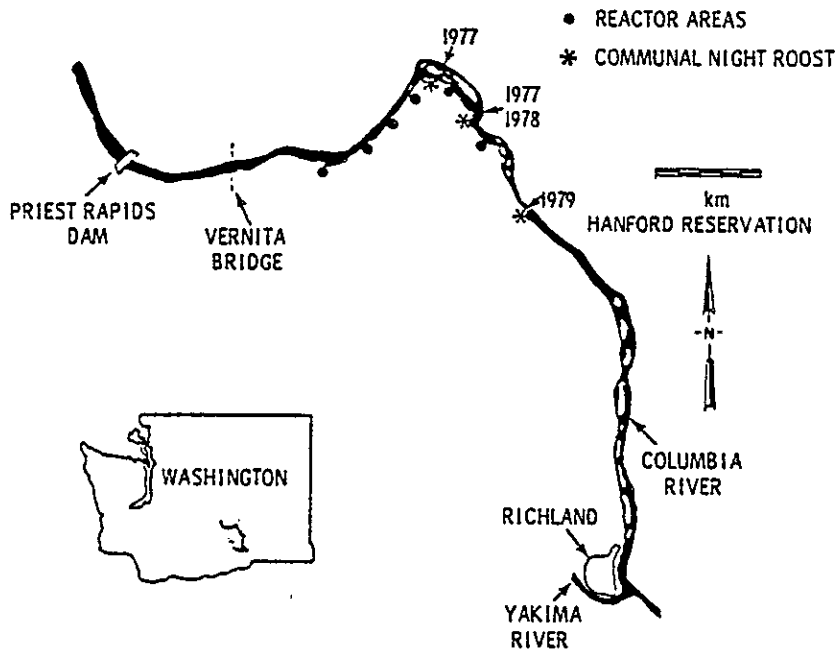

FIGURE 3.11. Three Communal Night Roosts Used by Bald Eagles

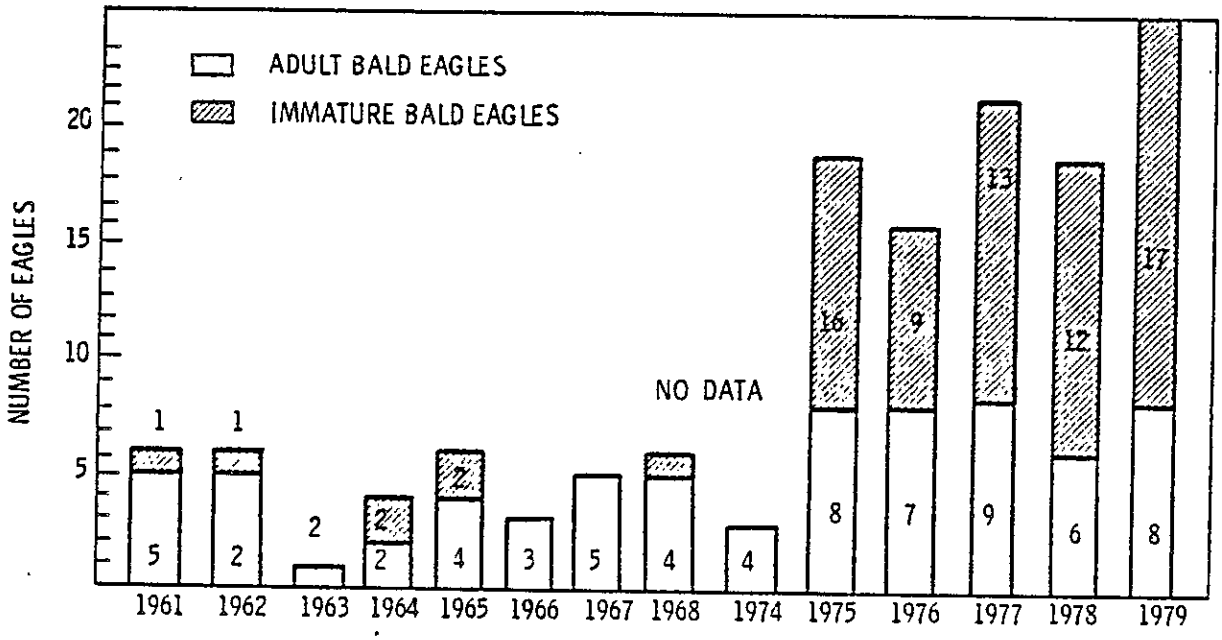

FIGURE 3.12. Wintering Bald Eagles (Fitzner and Hanson 1979)

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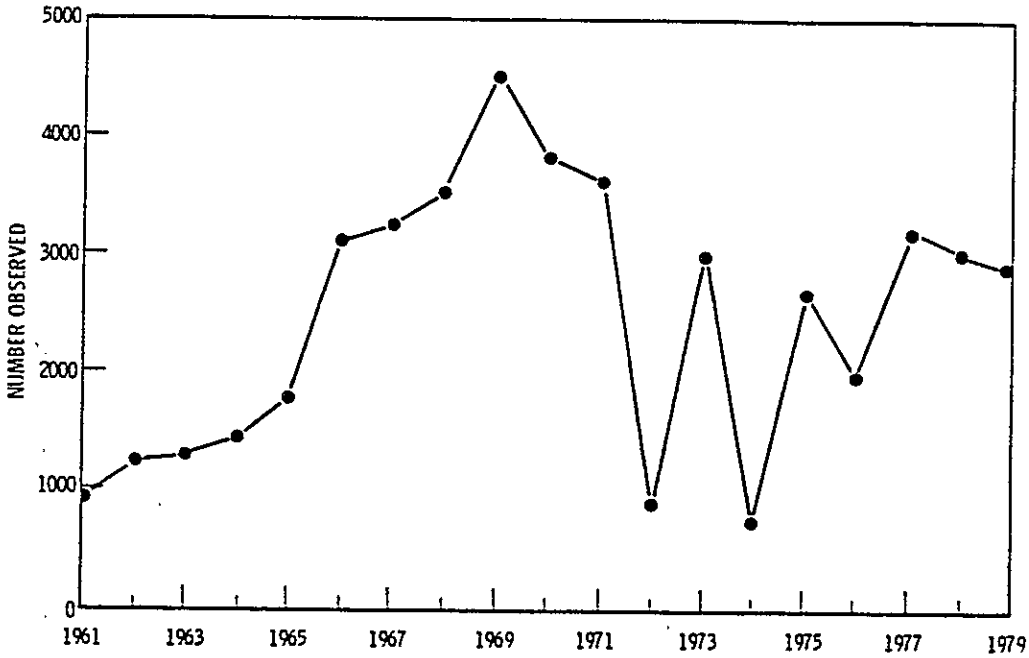

FIGURE 3.13. Chinook Salmon Redds Observed in Fall Along Hanford Reach (Fitzner and Hanson 1979; D. G. Watson, Battelle Northwest, Personal Communication)

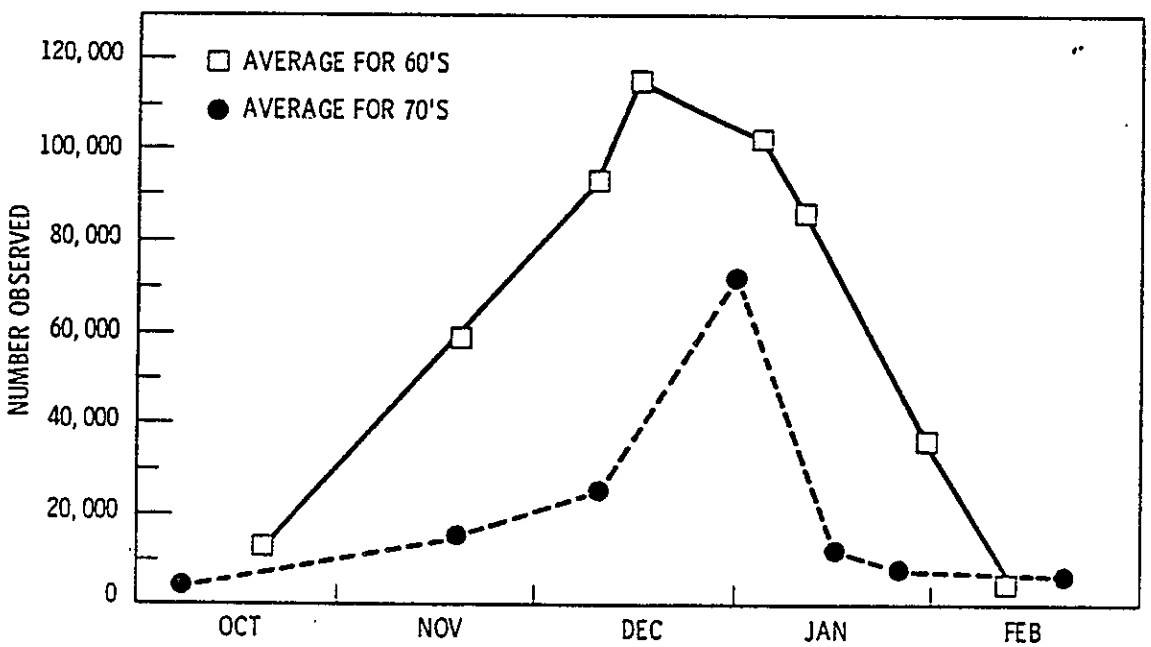

FIGURE 3.14. Average Number of Ducks Found Wintering on Hanford Reach (Fitzner and Hanson 1979)

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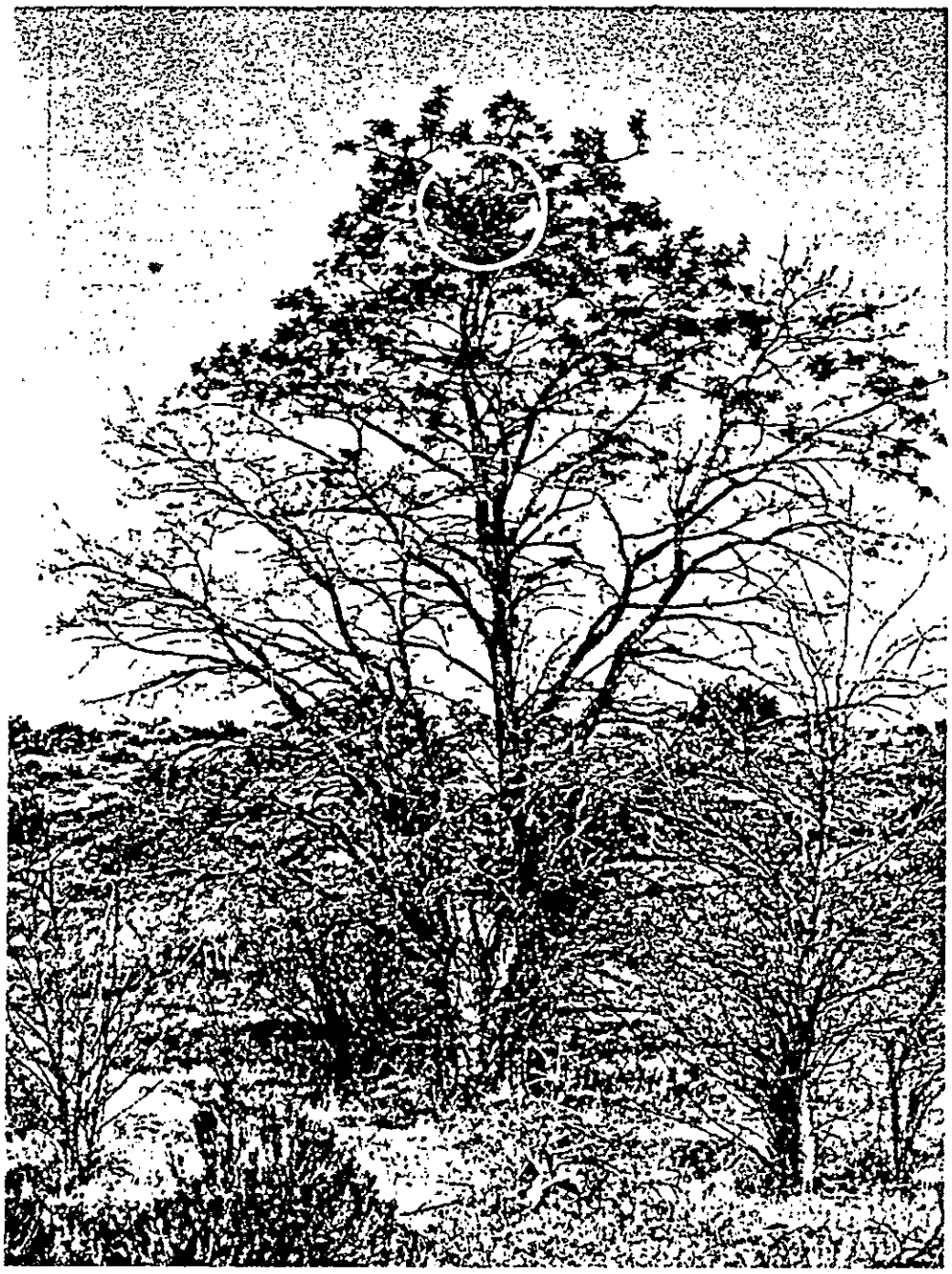

IGURE 3.15. A Swainson's hawk nest on the shoreline of the Columbia River near the site of the Ben Franklin Dam alternative

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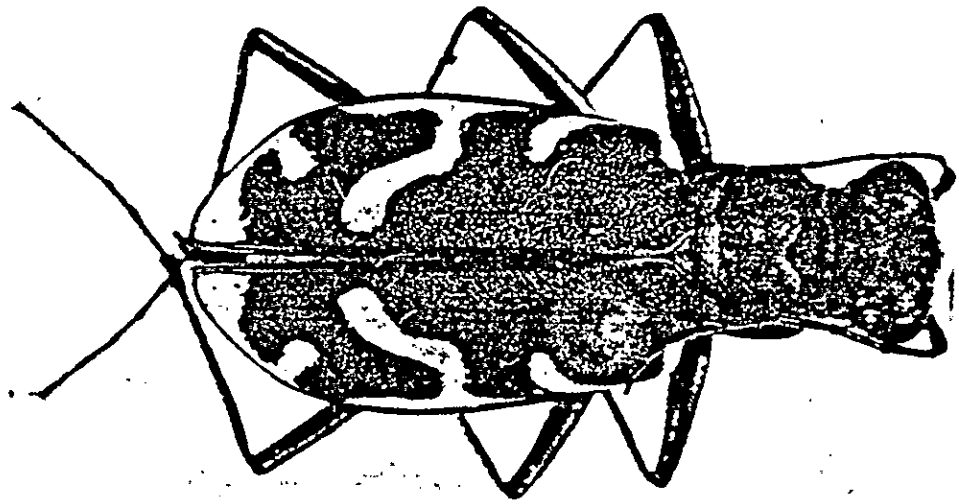

: 3.16. Columbia River Tiger beetles (Cicindela columbi
may live in sand dunes along the Hanford Reach

FIGURE 3.17. The Woodhouse's toad occurs in riparian areas along the Hanford Reach

9 2 1 2 0 7 7 2 0 3 1

FIGURE 3.18. Antelope-Bitterbrush habitat in the sand dune area.

FIGURE 3.19. The Pacific gopher snake, a common reptile of the Hanford Site.

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FIGURE 3.20. The desert night snake lives mostly in basalt rock outcroppings and talus slopes

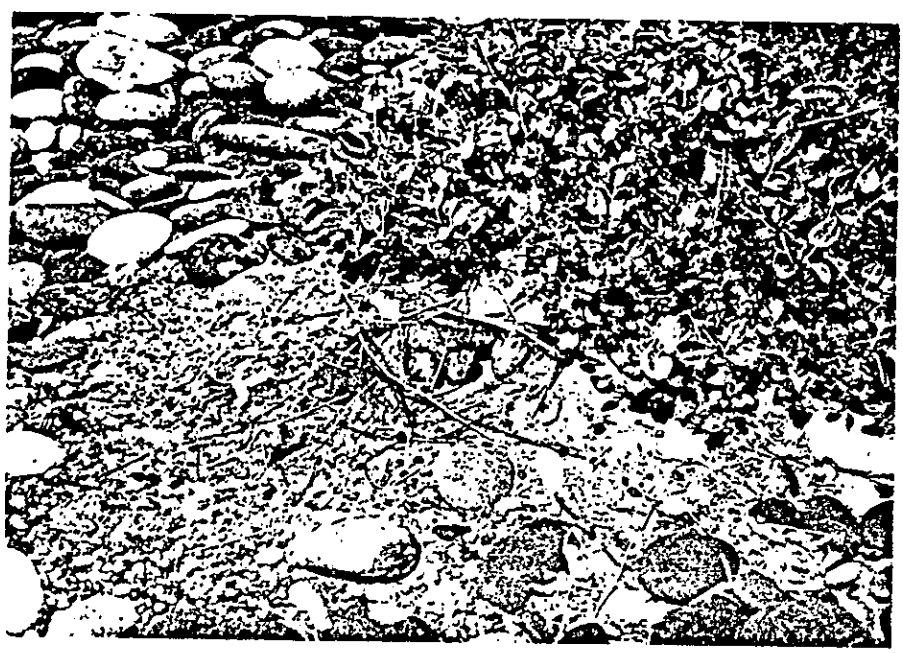

FIGURE 3.21. A Forster's tern nest in cobblestone substrate on Island 18

9 2 1 2 3 7 7 2 0 2 3

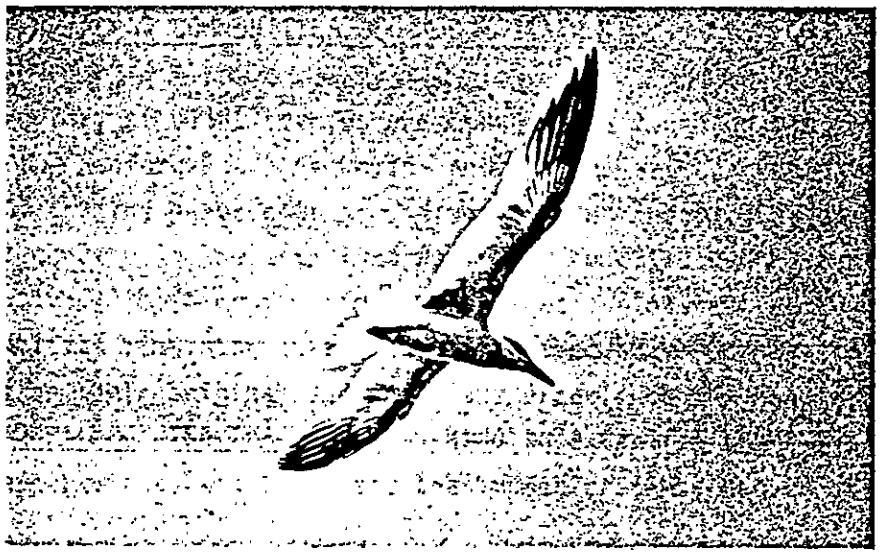

FIGURE 3.22. The Caspian tern is the largest (gull sized) tern nesting in Washington

FIGURE 3.23. Burrowing owls nest on the Hanford Site in deserted badger and coyote burrows

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4.0 PLANT COMMUNITIES OF UNIQUE STATUS ON THE HANFORD REACH

An inventory of plant species and communities found on the cobblestone beaches of the Hanford Reach shoreline and sloughs was conducted on August 12 and 13, 1980 for the purpose of providing detailed information on plant communities of concern in the area that would be inundated by the Ben Franklin Dam alternative. These communities are of special interest because they are the only habitats remaining on the Columbia River above Bonneville Dam that still exist on their original substrate and experience the conditions of a free-flowing river. The inventory was used to establish the relative uniqueness of these habitats and to assess the impact of the proposed project on them.

Five sites were investigated and are described along with graphic representations and floristic lists of each community. Sites were selected based on previous knowledge of the locations of extensive riparian areas along the reach and accessibility. All sites are located on the bank of the river. Sites 1, 2 and 3 represent the more common cobblestone beach communities of the Hanford Reach, while Site 4 represents those of silt substrate, such as slough areas. Site 5 was chosen to represent that portion of the Hanford Reach affected by the McNary Dam reservoir. These five sites contain typical riparian habitats of the Hanford Reach. However, not all communities on the reach were represented in the study sites. Different species lists and different dominant species would likely be generated from communities found on island shorelines, island slough areas, left bank (Franklin County) shorelines, and sand dune shorelines. The purpose of this study was to completely characterize some representative riparian communities of the Hanford Reach and to compare them with vegetative data documented on other reaches of the Columbia River. Because these five sites were investigated intensively, all species of plants were identified. Some species of special interest found on the sites are briefly mentioned below, and the occurrances of all species of concern (Washington Natural Heritage Data System 1980) are noted. Reference specimens were collected for unusual or taxonomically difficult species, and notes made on species dominance, density, and diversity. Relationship of communities to substrate, topography, water level and flow were also recorded.

Site #1, located immediately downriver from 100F Area, is moderately flat with a cobble substrate (Figure 4.1). It is a highly diverse site with five distinct riparian communities (Table 4.1). Species of concern, Rorippa calycina var. columbiae and Artemisia lindleyana, (Washington Natural Heritage Data System 1980) were found in zones 1-C and 1-D. Sites of this type seem to exist only where influenced by flowing water and display the highest diversity of both species and communities of any of the sites studied.

Site #2, located downriver from 100D area, is similar in slope, aspect, and substrate to Site #1 (Figure 4.2). Five distinct riparian communities were described for this site (Table 4.2) and it is possible that more existed downslope of 2-A but high water prevented further investigation in the time frame available. Although this site is similar in many respects to Site #1, no individual species of concern were reported. Because of the similarity in species composition found at high elevations at each of the two sites, it is expected that further investigation during low water would lead to the discovery of Rorippa and Artemisia. The low species richness of community 2-E is due to the high density of reed canarygrass (Phalaris arundinacea). Community 2-F is a vernal pool in which one of the dominant species is Marsilea vestita. Intensive searching for this species near previous reported sitings above Priest Rapids Dam (conducted by Joy Mastroguiseppe, curator of the Marion Ownbey Herbarium, and staff, Washington State University) failed to establish its existence. Futher study is suggested to establish the ability of this species to recolonize following permanent inundation. Community types similar to Site #1 and Site #2 are found along most of the right (west) shoreline. Although much more disturbed, the left (east) bank of the river contains communities of similar composition.

Site #3, located at White Bluffs Slough, is a natural slough along the Hanford Reach (Figure 4.3). Although diversity of species is relatively high in the communities represented here (Table 4.3), overall community diversity is low. This site appears to be typical of other slack-water sites, whether of natural or artificial origin.

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TABLE 4.1. Floristic List of Plant Species Found at Site No. 1, Hanford Reach

1-A

Uncolonized cobble inundated at most times

1-B

Carex athrostachya Olney
Coreopsis atkinsoniana Dougl.
Helenium autumnale L.[a]
Mentha arvensis L.[b]

1-C

Agrostis scabra Willd.[b]
Artemisia campestris ssp. caudata (Michx.) Hall & Clem.[b]
Artemisia lindleyana Bess.[c]
Asparagus officinalis L.[b]
Aster campestris var. campestris Nutt.[b]
Cirsium arvense (L.) Scop.
Convolvulus arvensis L.
Coreopsis atkinsoniana Dougl.
Helenium autumnale L.[a]
Mentha arvensis L.[b]
Morus alba L.
Phalaris arundinacea L.
Plantago major L.
Portulaca oleracea L.
Potentilla paradoxa Nutt.
Rorippa calycina var. columbiae (Suksd.) Rollins[b,c]
Rorippa islandica (Oed.) Borbas[b]
Rorippa nasturtium-aquaticum (L.) Schinz. & Thell.
Rosa spp.
Salix spp.
Taraxacum officinale Weber
Veronica peregrina var. xalapensis (H.B.K.) St. John & Warren

1-D

Agrostis alba var. stolonifera (L.) Smith
Artemisia lindleyana Bess.[a,c]
Asclepias speciosa Torr.
Aster campestris var. campestris Nutt.[b]
Coreopsis atkinsoniana Dougl.[a]
Euphorbia serpyllifolia pers.[b]
Grindelia columbiana (Piper) Rydb.
Phalaris arundinacea L.[a]
Polygonum persicaria L.[b]
Rorippa calycina var. columbiae (Suksd.) Rollins[b,c]
Salix spp.
Sonchus oleraceus L.
Verbena hastata L.
Xanthium strumarium L.

1-E

Agropyron caninum ssp. majus (Vasey) Hitch.[a]
Artemisia campestris ssp. caudatus (Michx.) Hall & Clem.[a]
Bidens frondosa L.[b]
Conyza canadensis (L.) Cronq.
Grindelia columbiana (Piper) Rydb.
Panicum capillare L.[b]
Setaria lutescens (Weigel) Hubb.
Sitanian hystrix (Nutt.) Smith[b]
Verbena bracteata Lag. & Rodr.

1-F

Agropyron canium ssp. majus (Vasey) Hitch.[a,b]
Artemisia campestris ssp. caudatus (michx.) Hall & Clem.[a,b]
Bromus tectorum L.
Epilobium paniculatum Nutt.
Grindelia columbiana (Piper) Rydb.
Lupinus sulphureus var. subsaccatus (Suksd.) Hitch.[a,b]

(a) Dominant species in community
(b) Taxa not recorded in previous studies of the Hanford Reach
(c) Species of concern (Washington State Department of Natural Resources and Washington Natural Heritage Program, 1980)

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TABLE 4.2. Floristic List of Plant Species Found at Site No. 2, Hanford Reach

2-A

Carex athrostachya Olney
Deschampsia atropurpurea var. latifolia (Hook.) Scribn.(b)
Helenium autumnale L.
Polygonum persicaria L.(a,b)
Ranunculus flammula L.
Salix spp.
Veronica anagallis-aquatica L.(a)
Veronica peregrina var. xalapensis (H.B.K.) St. John & Warren

2-B

Allium schoenoprasum L.
Aster campestris var. campestris Nutt.(b)
Carex athrostachya Olney
Coreopsis atkinsoniana Dougl.(a)
Deschampsia atropurpurea var. latifolia (Hook.) Scribn.(b)
Helenium autumnale L.(a)
Plantago major L.(a)
Polygonum persicaria L.(b)
Potentialla norvegica L.(b)
Ranunculus flammula L.
Salix spp.(a)

2-C

Allium schoenoprasum L.
Artemisia ludoviciana Nutt.(a)
Bromus tectorum L.
Conyza canadensis (L.) Cronq.
Coreopsis atkinsoniana Dougl.
Epilobium paniculatum Nutt.(b)
Gaillardia aristata Pursh.(a)
Gnaphalium palustre Nutt.
Grindelia columbiana (Piper) Rydb.
Lupinus sulphureus var. subsaccatus (Suksd.) Hitch.(b)

2-C (continued)

Melilotus alba Desr.
Sporobolus cryptandrus (Torr.) Gray
Xanthium strumarium L.

2-D

Agropyron smithii Rydb.(b)
Allium schoenoprasum L.
Artemisia ludoviciana Nutt.
Bromus tectorum L.(a)
Conyza canadensis (L.) Cronq.
Cyperus aristatus Rottb.(b)
Epilobium paniculatum Nutt.(b)
Euphorbia serpyllifolia Pers.(b)
Grindelia columbiana (Piper) Rydb.(a)
Salsola iberica Sennen & Pau(b)
Sporobolus cryptandrus (Torr.) Gray(a)

2-E

Cirsium arvense (L.) Scop.
Lactuca serriola L.
Phalaris arundinacea L.(a)

2-F

Achillea millefolium L.
Agropyron smithii Rydb.(a,b)
Conyza canadensis (L.) Cronq.
Equisetum hyemale L.(a)
Lactuca serriola L.
Rumex crispus L.

2-G

Salsola iberica Sennen & Pau(b)
Sisymbrium altissimum L.
Solidago gigantea Ait.(b)

(a) Dominant species in community
(b) Taxa not recorded in previous studies of the Hanford Reach

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TABLE 4.3. Floristic List of Plant Species Found at Site No. 3, Hanford Reach

3-A

Agropyron repens (L.) Beauv.
Agrostis tenuis Sibth.[b]
Allium schoenoprasum L.
Artemisia ludoviciana Nutt.
Asclepias speciosa Torr.
Cirsium vulgare (Savi) Tenore[b]
Lactuca serriola L.
Lycopus asper L.[b]
Phalaris arundinacea L.[a]
Poa pratensis L.[a]
Rumex crispus L.
Sisymbrium altissimum L.
Solidago occidentalis (Nutt.) T. & G.[a]
Verbascum thapsus L.

3-B

Agrostis scabra Willd.[b]
Aster campestris var. campestris Nutt.[b]
Coreopsis atkinsoniana Dougl.
Eleocharis palustris (L.) R. & S.[a]

3-B (continued)

Gnaphalium microcephalum Nutt.[b]
Helenium autumnale L.
Juncus Articulatus L.[a]
Juncus balticus Willd.
Lycopus asper Greene[b]
Phalaris arundinacea L.
Plantago major L.
Polygonum persicaria L.[b]
Prunella vulgaris L.[b]
Salix spp.
Scirpus validus Vahl.[a]
Sonchus uliginosus Bieb.[b]
Triglochin maritimum L.
Verbena hastata L.

3-C

Uncolonized bare, steep, cobble

3-D

Open shallow water; thin silt layer over cobble substrate

(a) dominant species in community
(b) taxa not recorded in previous studies of the Hanford Reach

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Gnaphalium microcephalum was collected from zone 3-A. Because this is far beyond the previously recorded range of the plant's ecologic amplitude and the specimen varied from the standard chemo-taxonomic characters used in identification, further investigation is necessary to determine if these plants represent a new taxonomic form.

Site #4, located at Hanford Slough, was along a much wider section of slough and was studied to ascertain the effect of a silt substrate on species and community diversity (Figure 4.4, Table 4.4). Zone 4-B was dominated by a very low density of small plants of Rotala ramosior. It also contained a variety of seedlings which will likely not mature in the remainder of the growing season due to late high water.

Site #5 (Figure 4.5) is near the upper end of McNary Pool (Lake Wallula) across from Island 18 and vegetatively is quite similar to Site #4, except that the cobble substrate of the beach provides for an additional community (5-C, see Table 4.5). It should be noted, however, that this community is dissimilar to any found in Sites #1 and #2 and consists mostly of "weedy" species, such as milkweed (Asclepias speciosa) and cocklebur (Xanthium strumarium). The totally aquatic vegetation of zone 5-A is common to many shallow slack-water sites. Salix-dominated communities like those of Site #5 are found all along the shoreline of the McNary Pool and along the lowermost portion of the Hanford Reach shorelines and islands affected by the McNary Pool.

Tabor et al. (1980) studied Columbia River riparian vegetation along Wells, McNary, Hanford, John Day, and Bonneville reaches and below Bonneville. Comparisons of the present study with Tabor's was based on whether or not dominant plant species and the majority of plants in association with them were documented in other areas of the Columbia River. Zones 1-D (Coreopsis atkinsoniana - Phalaris arundinacea) and 3-B (Eleocharis palustris, Scirpus validus) were both described by Tabor as occupying the McNary Reach. Zones 2-E (Phalaris arundinacea), 4-D and 5-D (Salix sp) are described in all reaches studied. No forb dominated areas inventoried in this study were described by Tabor et al. (1980).

TABLE 4.4. Floristic List of Plant Species Found at Site No. 4, Hanford Reach

4-A
Open water of main river channel

4-B
Rotala ramosior (L.) Koehne.[a,b]
Limosella aquatica L.[b]

4-C
Helenium autumnale L.[a]
Lycopus asper Greene[a,b]

4-D
Artemisia dracunculus L.[b]
Asclepias speciosa Torr.

4-D (continued)
Cirsium arvense (L.) Scop.
Clematis ligusticifolia Nutt.[b]
Helenium autumnale L.
Lactuca serriola L.
Lycopus asper Greene[b]
Phalaris arundinacea L.
Salix spp.[a]
Solidago occidentalis (Nutt.) T. & G.

4-E
Artemisia tridentata Nutt.
Agropyron spicatum (Pursh.) Scribn. & Smith

(a) Dominant species in community
(b) Taxa not recorded in previous studies of the Hanford Reach

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TABLE 4.5. Floristic List of Plant Species Found at Site No. 5, Hanford Reach

5-A
Elodea canadensis Rich. in Michx.[a]
Myriophyllum spp.
Potamogeton crispus L.
Potamogeton pectinatus L.

5-B
uncolonized cobble

5-C
Asclepias speciosa Torr.[a]
Convolvulus arvensis L.
Equisetum hymale L.
Euphorbia serpyllifolia Pers.
Lactuca serriola L.
Oenothera strigosa Mkze. & Busn
Panicum capillare L.
Phalaris arundinacea L.
Rumex crispus L

5-C (continued)
Salix spp.
Verbascum thaspus L.
Xantnium strumarium L.[a]

5-D
Artemisia dracunculus L.[b]
Asclepias speciosa Torr.
Cirsium arvense (L.) Scop.
Clematis ligusticifolia Nutt.[b]
Helenium autumnale L.
Lactuca serriola L.
Lycopus asper Greene[b]
Phalaris arundinacea L.
Salix spp.[a]
Solidago occidentalis (Nutt.) T. & G.

5-E
Artemisia tridentata Nutt.
Agropyron spicatum (Pursh.) Scribn. & Smith

(a) Dominant species in community
(b) Taxa not recorded in previous studies of the Hanford Reach

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A summary of plant community composition for Columbia River reaches reported by Tabor et al. (1980) is presented in Table 4.6. Percentages were obtained by summing acreage dominated by plant species in leach botanical category i.e., trees, shrubs (almost exclusively willow species), grasses, grass-like plants (reeds, sedges, and cattails), and forbs and dividing by the total acreage described for each reach. The Hanford Reach is the only section surveyed that has such a vast amount of forb-dominated shoreline. The grass-dominated areas are most likely those of the slough areas on the reach that are dominated by Phalaris arundinacea. The John Day Reach contains a large portion of forb dominated area, one-third of which consists of a Rumex crispus - Solidago occidentalis (curly dock - Western Goldenrod) association, both common weeds. This community is not found on the Hanford Reach. The McNary Reach, just downriver from Hanford Reach, is shown to be characterized by large amounts of willow and reed - cattail growth.

TABLE 4.6. Percent Composition of Shoreline Riparian Vegetation Along Columbia River Reaches (after Tabor et al. 1980)

Reach	% Tree	% Shrub	% Grass	% Grasslike	% Forb
Hanford	0	0	34	0	66
Wells	0	23	43	27	7
McNary	1	36	8	47	9
John Day	27	10	13	16	33
The Dalles	12	72	1	3	10
Bonneville	8	71	12	3	5
Below Bonneville	30	60	5	6	0

It is difficult to assess the relative uniqueness of the individual plant communities of the Hanford Reach because of the lack of a complete inventory of riparian plant communities of Northwest river systems. Thus the importance of the Hanford Reach plant communities must be based on the unique status of the habitat and the limited post-impoundment data for other reaches.

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The following factors contribute to the unique status of the Hanford Reach riparian cobble communities:

- The Hanford Reach is the last free-flowing segment of the several hundred miles of Columbia River in Washington. Therefore plant communities and riparian habitats represent relatively natural communities. The creation of a slack-water environment as a result of impoundment has affected the vegetation of reaches on the Columbia River by increasing the establishment of trees, shrubs and weedy forbs in place of the native plant species adapted to the rapid-flow current and seasonal flooding regime of the free-flowing river. The physiognomic differences in vegetation between the free-flowing Hanford Reach and other reaches of the Columbia River (native forb dominated communities of the Hanford Reach versus tree-shrub dominated communities of reservoir areas) exemplify the changes in dominant plant species expected to occur on the Hanford Reach should the Ben Franklin Dam alternative be constructed. The Hanford Reach represents the last segment of the Columbia River that still possesses its original shoreline and island substrates. Riparian cobble communities of the Hanford Reach are considered unique habitat which could not be recreated after inundation of their original substrates.

- The area of the Hanford Reach within the Hanford Site has been protected from disturbance by the general public and from grazing for the last 37 years (Rickard et al. 1980). Although the area cannot be considered totally undisturbed, the long protective status has allowed remnants of the pristine state to remain. Within this area are many native plant communities. For example, the arid island cobble community dominated by Eriogonum compositum and Lupinus wyethii (Fickeisen et al. 1980) is found extensively only on the Hanford Reach.

All sites surveyed and the communities they contain would be inundated by the Ben Franklin Dam alternative. New shoreline created by its pool would be of sand-silt substrate rather than cobble as is presently the case on the

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majority of the reach. As was emphasized in a previous riparian study (Fickeisen et al. 1980), this change in substrate would produce riparian communities dominated by willows, reed canarygrass and weedy forbs rather than the predominant fall-blooming forb species found presently.

Willow dominated communities are already established in that portion of the Hanford Reach affected by the McNary Pool (Zone 5-D) as well as in silty slackwater areas such as Hanford Slough (Zone 4-D). It is expected that the Hanford Reach riparian vegetation would be quite similar in appearance to the McNary Reach following inundation.

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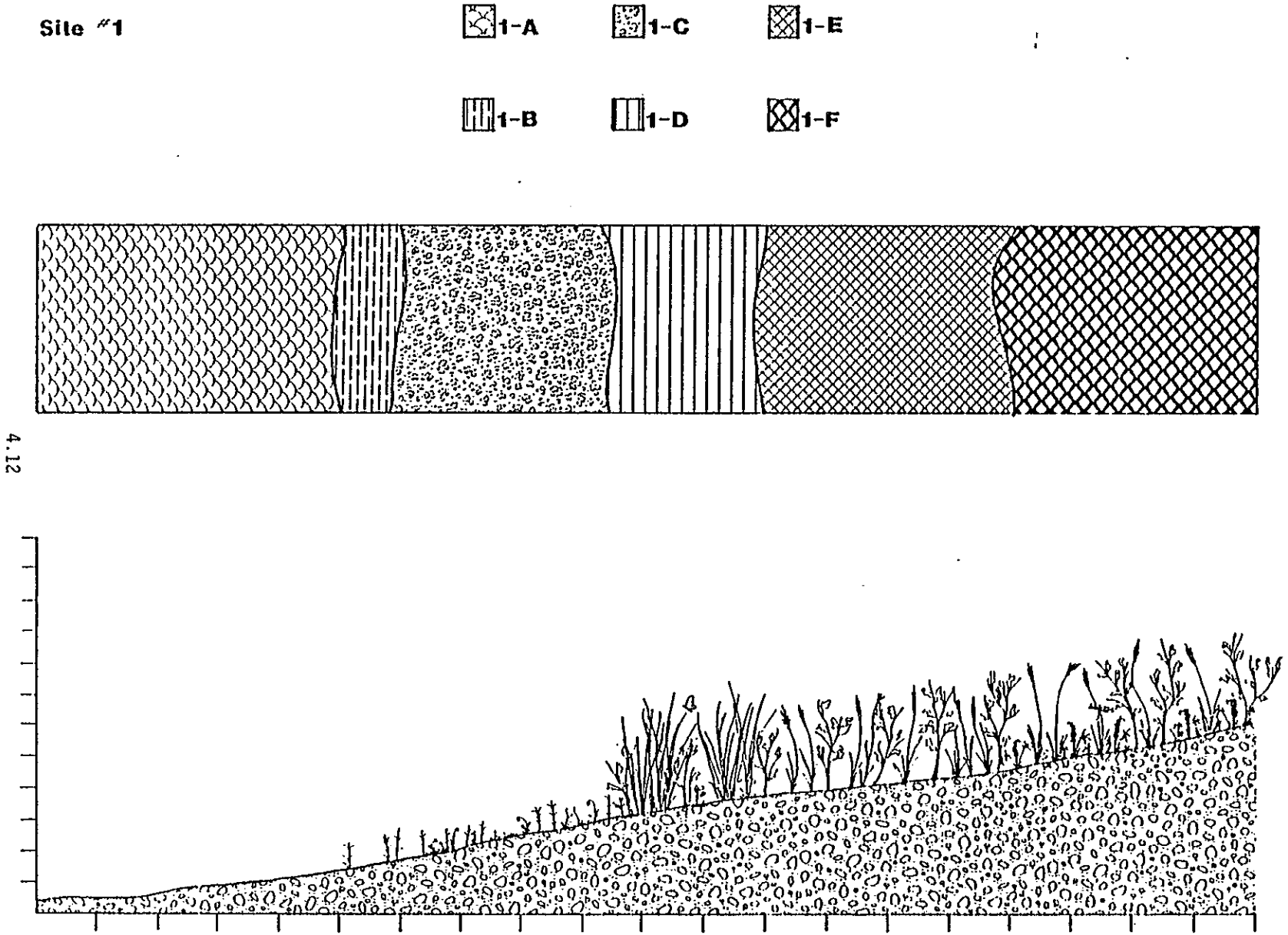

FIGURE 4.1. Shoreline Profile of Riparian Communities at Site #1, Hanford Reach

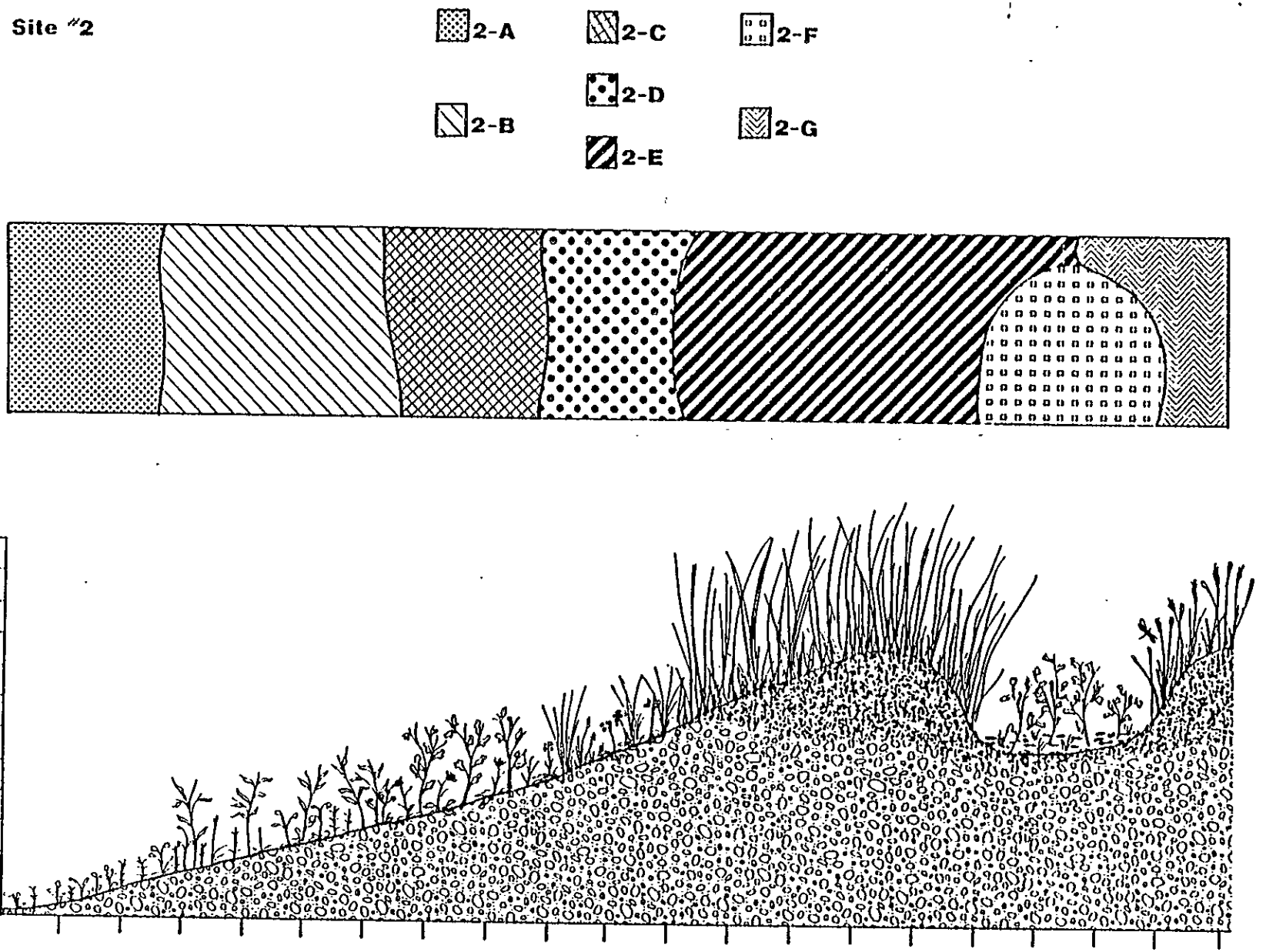

FIGURE 4.2. Shoreline Profile of Riparian Communities at Site #2, Hanford Reach

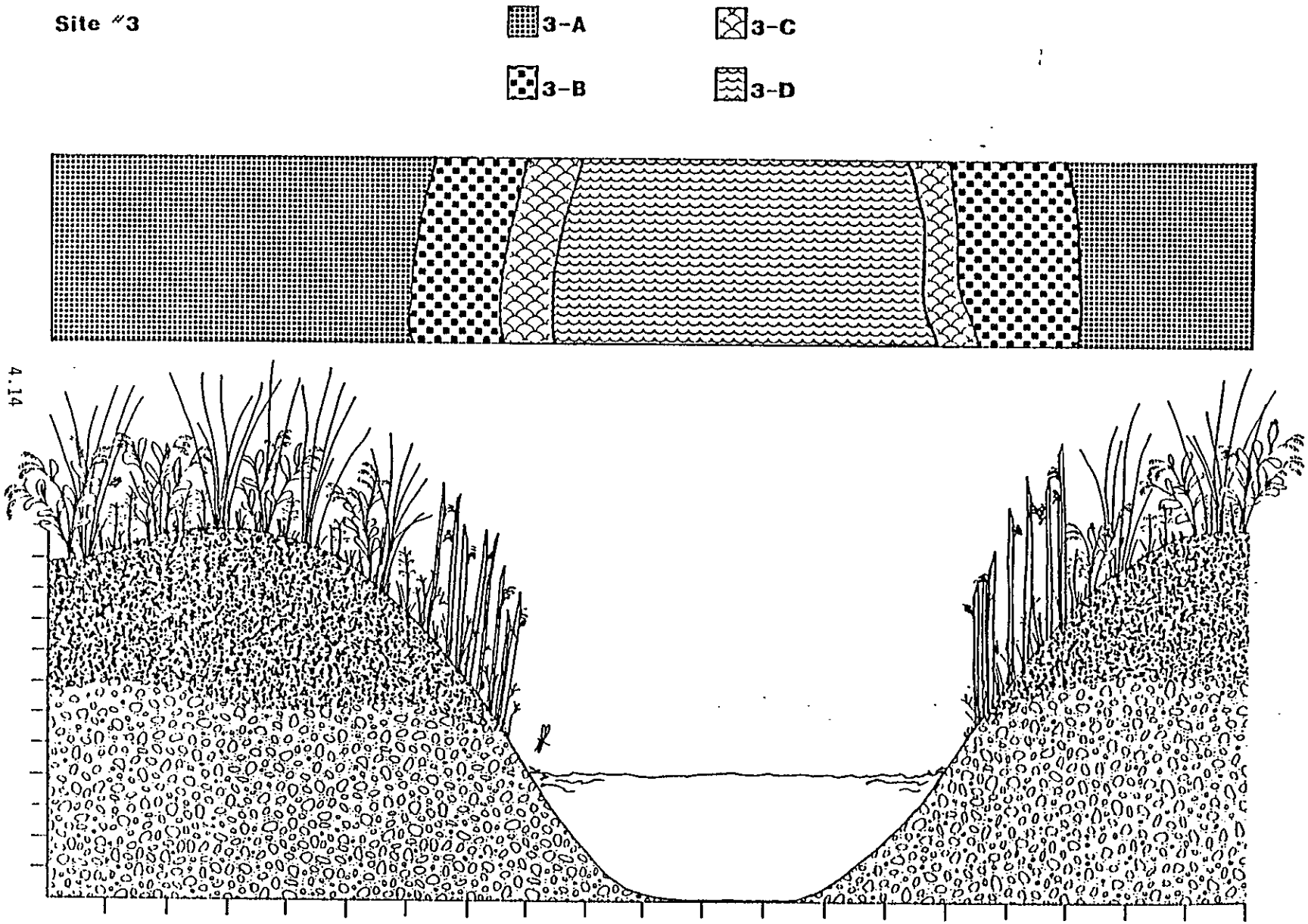

FIGURE 4.3. Shoreline Profile of Riparian Communities at Site #3, Hanford Reach

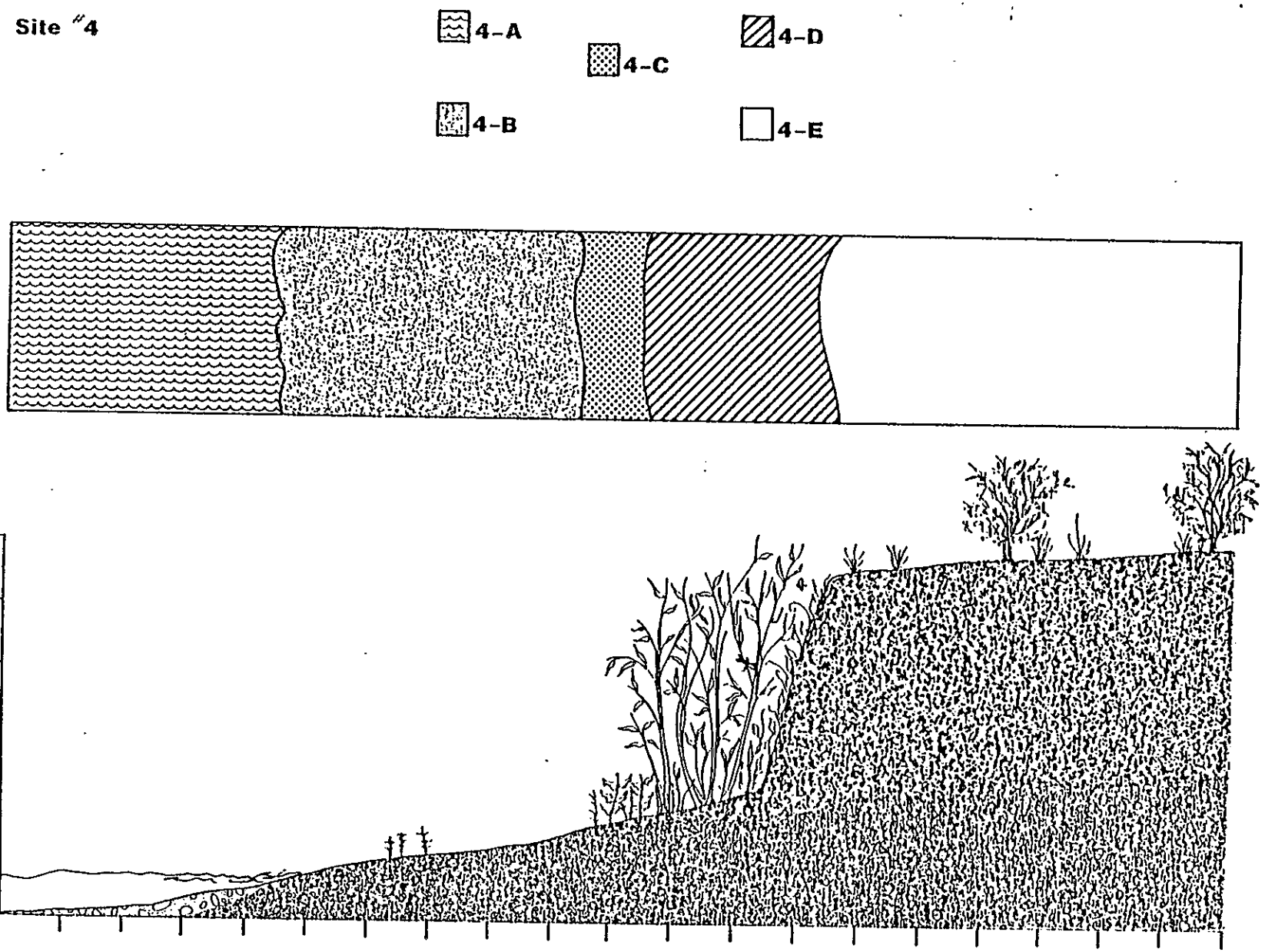

FIGURE 4.4. Shoreline Profile of Riparian Communities at Site #4, Hanford Reach

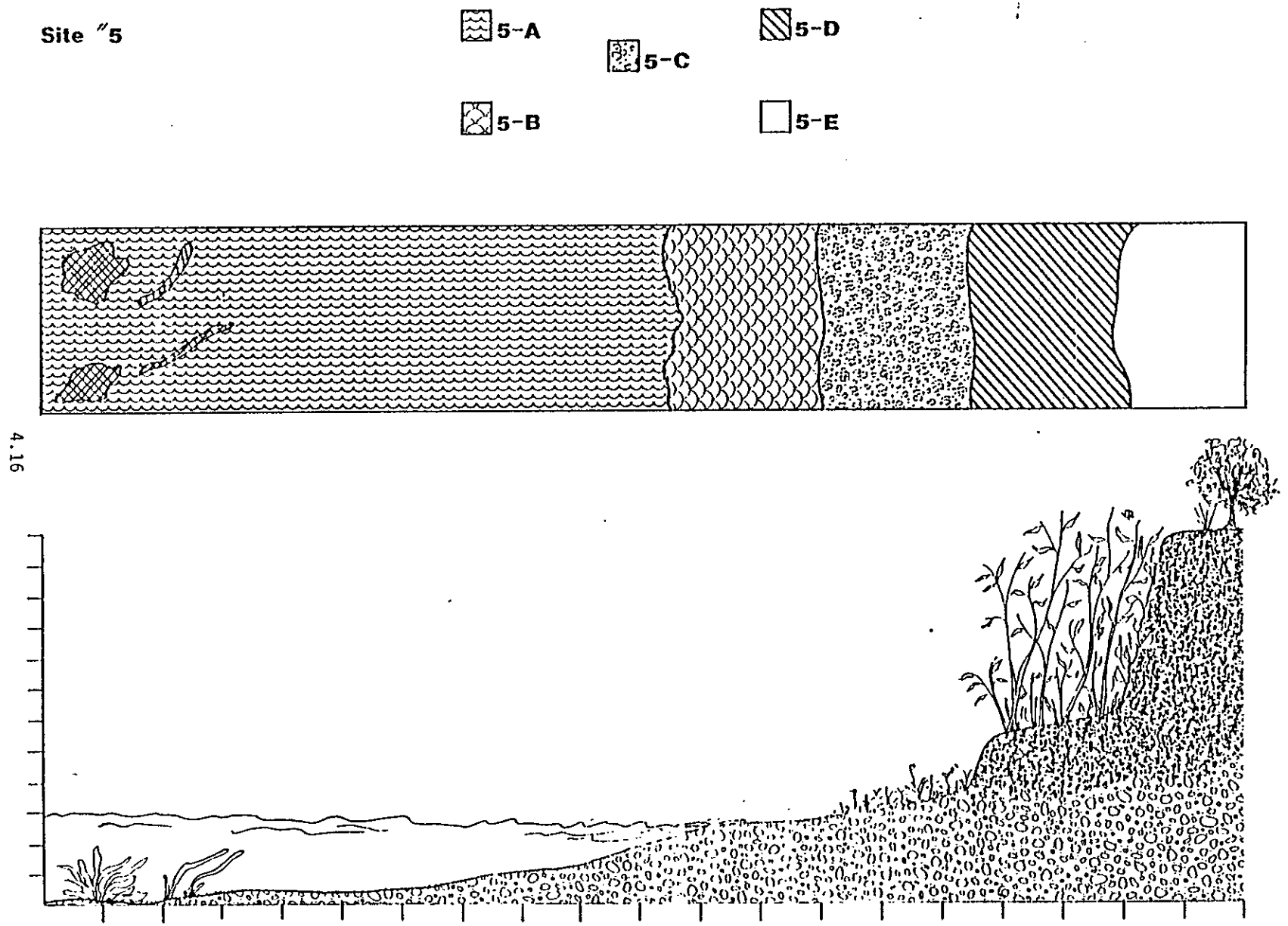

FIGURE 4.5. Shoreline Profile of Riparian Communities at Site #5, Hanford Reach

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